D83 4-N
606

NSI. 18/4: 989-91

ORIGINAL
COMPLETED

FEDERAL R&D FUNDING BY BUDGET FUNCTION:

FISCAL YEARS 1989-91

REPORT PREPARED BY:

NATIONAL SCIENCE FOUNDATION
Directorate for Scientific, Technological, and International Affairs
Division of Science Resources Studies
Government Studies Group

Washington, D.C.
20550

NSF 90-311

April 1990

FEDERAL R&D FUNDING BY BUDGET FUNCTION:

FISCAL YEARS 1989-91

REPORT PREPARED BY:

NATIONAL SCIENCE FOUNDATION
Directorate for Scientific, Technological, and International Affairs
Division of Science Resources Studies
Government Studies Group

Washington, D.C.
20550

NSF 90-311

April 1990

I

Availability of Publications

Extra copies of this report are available from the Government Studies Group, Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550 or (202) 634-4636.

Telephonic Device for the Deaf

The National Science Foundation has Telephonic Device for the Deaf (TDD) capability which enables individuals with hearing impairment to communicate with the Division of Personnel and Management for general information and information relating to NSF programs or employment. The TDD number is (202) 357-7492.

Suggested Citation

National Science Foundation, Federal R&D Funding by Budget Function, Fiscal Years 1989-91, NSF 90-311, (Washington, D.C., 1990).

NOTES TO THE READER

This annual report provides information on Federal funding of research and development (R&D) by Federal budget function categories. The report focuses exclusively on the R&D components of agency programs as proposed by the administration for fiscal year (FY) 1991. Descriptions of over 500 individual R&D programs are included. R&D data are classified into the same budget function categories used in the Budget of the United States Government, Fiscal Year 1991. Proposed FY 1991 funding levels are given in budget authority which is the basis for initial congressional action. Detailed data are also included on actual Federal funds directed toward R&D in FY 1989 and estimated funding in FY 1990.

These notes introduce the reader to the basic budget terms and concepts that will be used throughout the report. The first chapter provides an overview of Federal funding of R&D within the context of requested total Federal budget authority. The following chapters focus on research and development activities conducted within each budget function. The budget functions are presented in descending order of the requested budget authority for R&D in fiscal year 1991. Each chapter includes an overview of the function and a summary table, followed by more detailed tables and text describing the major R&D program areas within the function. Three historical data series are in the Appendix: (1) Federal funding for national defense and civilian R&D in current and constant 1982 dollars for the period FY 1955-1991, (2) Federal R&D funding by function for the period FY 1955-1991, and (3) Federal basic research funding for the period FY 1978-1991.

Conduct of Research and Development

Research and development in this report consists of basic and applied research in the sciences and in engineering and activities in development, all defined below.

- **Research** is systematic study directed toward fuller scientific knowledge or understanding of the subject studied. Research is classified as either basic or applied according to the objectives of the sponsoring agency.
  - In **basic research** the objective of the sponsoring agency is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.
  - In **applied research** the objective of the sponsoring agency is to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.
- **Development** is the systematic use of the knowledge or understanding gained from research, directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes. It excludes quality control, routine product testing, and production.

AGENCY/FUNCTION CROSSWALK

AGENCIES	National defense (050)	Health (550)	Space research and technology (250)	General science (250)	Energy (270)	Transportation (400)	Natural resources and environment (300)	Agriculture (350)	Education, training employment and social services (500)	Veterans benefits and services (700)	International affairs (150)	Commerce and housing credit (370)	Community and regional development (450)	Administration of justice (750)	Income security (600)	General government (800)
Department of Defense (Military)	X															
Dept. of Health and Human Services		X							X						X	
Nat'l Aeronautics and Space Admin.			X			X										
Department of Energy	X			X	X											
National Science Foundation				X												
Department of Agriculture							X	X								
Department of the Interior							X									
Environmental Protection Agency					X		X									
Department of Transportation						X										
Department of Commerce							X					X	X			
Department of Veterans Affairs										X						
Agency for Int'l Development											X					
Department of Education									X							
Nuclear Regulatory Commission					X											
Smithsonian Institution									X							
Tennessee Valley Authority													X			
Department of the Treasury														X		X
Corps of Engineers-Civil Works							X									
Department of Justice														X		
Department of Labor		X							X						X	
Dept. of Housing and Urban Devel.													X			

SOURCE: National Science Foundation, SRS

Funds for the conduct of R&D also include personnel, program direction, and administrative support costs directly associated with R&D activities. Expendable or movable equipment necessary for the conduct of R&D, such as microscopes or spectrometers, are also included in R&D.

Funds for R&D facilities, such as reactors, wind tunnels, or particle accelerators, or the construction, repair, or alteration of such facilities are categorized as funds for R&D plant. This report excludes R&D plant funds. It also excludes all non-R&D activities that are performed within functions that conduct research and development, and all budget functions in which no research and development is conducted.

Agencies and Budget Functions

All activities within the Federal budget, including R&D, are classified into functional categories. Funding for these 20 functions comprises the Federal budget total. Agencies' activities are not necessarily included in only one function. Instead, it is typical for one agency to have its programs distributed across functions and for each function to include programs from multiple agencies. There is no overlap between functions or the agency programs within the functions. In a few cases, components of a major national effort, such as the National Aerospace Plane, are funded through multiple functions. However, each specific R&D activity is assigned to only one functional area consistent with the official codes used in budget documents.

Functional categories and definitions used in this report are the same as those used in the Federal budget with one exception. The Federal budget function of general science, space, and technology (function 250) has been divided into two R&D functions: general science containing the activities in subfunction 251, and space research and technology containing the activities of subfunctions 253, 254, and 255. Five Federal budget functions -- medicare (function 570), social security (function 650), net interest (function 900), allowances (function 920) and undistributed offsetting receipts (function 950) -- have no research or development components and are excluded from this report, except with respect to the discussion of R&D as a proportion of total Federal budget authority. The agency/function crosswalk table presents the agencies contributing support to the 16 individual research and development functions, listed by title and functional code.

Budget Authority, Obligations, and Outlays

The Federal R&D funding data presented in this report are, with a few noted exceptions, provided in budget authority. Budget authority is used because it is the initial budget parameter for congressional action on the President's proposed budget. Budget authority imposes a ceiling on obligations and outlays; obligations and outlays flow from budget authority.

- **Budget authority** is the primary source of legal authorization to enter into obligations that will result in outlays. Budget authority is most commonly granted in the form of appropriations by the congressional committees assigned to determine the budget for each function.

- **Obligations** represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated and when the future payment of money is required.

- **Outlays** represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated or obligated.

Sources of Data

In the Federal budget, most funds for research and development are not line items in an agency's budget submission, but are included within general program funding. In order to determine the funding for Federal research and development, the Office of Management and Budget (OMB) requires the agencies with annual R&D funding greater than $10 million to submit data on their R&D programs as part of their annual budget submissions. These data are reported in the form of an Exhibit 44A in response to OMB Circular A-11 and provide information on funding levels for the conduct of R&D (basic research, applied research, and development), R&D facilities, and a memo entry on R&D support to universities and colleges.

In the President's proposed FY 1991 budget, the presentation of information on R&D differed from previous years in several respects. Traditionally, a special analysis on research and development was a part of a series of budget documents and included data on R&D funding by agency as well as brief descriptions of major agencies' R&D activities. This year, there was a single budget document and R&D was discussed in the context of the Nation's scientific and technological efforts in part III.C., "Enhancing Research and Development," which was one of ten components in the budget document's third section, "Investing in the Future."

In addition to general data on R&D funding, "Enhancing Research and Development" presented information on several science and technology-related initiatives and activities that included funding both for R&D and for activities that are not considered to be R&D. The budget also contained the results of cross-cutting reviews of the resources that Federal agencies are directing toward R&D in specific areas, including advanced imaging technologies, high performance computing, magnetic levitation transportation, robotics, semiconductors, and superconductivity. These reviews were conducted as part of the budget process to determine agencies' activities in the specified areas, their relationship to agency missions, and the level of coordination among agencies. Inclusion in the cross-cutting review does not necessarily indicate that a technology is targeted for special consideration in funding decisions. The R&D portion of the activities included in the initiatives and reviews are embedded in a myriad of programs in several functions. In this report, funding for these R&D activities is discussed in the context of the function and program of which they are a part. Major changes in funding are noted on the highlights page at the beginning of the appropriate functions.

The data in this report are based primarily on data provided by 21 agencies to OMB as part of the budget process. The report also incorporates information that has become available from the individual agencies after the administration's budget was prepared, including agency budget justification documents submitted to the Congress and supplemental program-specific information gathered through contact with agency budget and program staff through mid-March. Therefore, the budget numbers for individual activities, programs, or agencies may differ from those published in the President's budget or agency budget documents. The data do, however, represent the best estimates of proposed Federal funding for R&D available at the time of publication.

Other Science Resources Studies Reports on Federal R&D Funding

In addition to this report, the Division of Science Resources Studies (SRS) annually publishes three reports related to Federal R&D funding.

Federal Funds for Research and Development, Detailed Statistical Tables reports the results of a survey of 33 Federal agencies' obligations and outlays for research and development and R&D plant (facilities). Detailed information on agency obligations by field of science and engineering, performer, and character of work also are included.

Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Detailed Statistical Tables includes data on all Federal obligations (excluding direct loans) to individual universities, colleges, and nonprofit institutions. Data are collected from the 15 agencies that provide virtually all of the Federal funding for science and engineering R&D to academic institutions. In addition to conduct of R&D and R&D plant, the survey collects data on obligations for facilities and equipment for science education, fellowships, traineeships and grants, and more general direct support from the Federal Government for all activities including, but not limited to, those directly related to science and engineering.

National Patterns of R&D Resources includes information on R&D expenditures by different performers including industry, academia, and the Federal Government. The expenditures data in National Patterns, with the exception of Federal intramural research and development, are based on sample surveys of the performers of R&D. Respondents are asked to report how much they actually spent on R&D during the year and the source of those funds. The data in National Patterns may differ from data in this report for several reasons. Data in National Patterns are based on expenditures reported by performers; performers of R&D often expend Federal funds in a different year than the one in which the Federal Government provided authorization, obligations, or outlays. National Patterns data are based on a calendar year while this report's data are for fiscal years. In addition, the two reports use different concepts and definitions, but similar terminology when reporting the data by functional category. For example, this budget function report distributes the budget authority of the National Aeronautics and Space Administration (NASA) between the space research and technology function and the transportation function as is done in the President's budget; National Patterns reports all expenditures flowing from NASA funding as expenditures for space R&D.

ACKNOWLEDGMENTS

This report was prepared in the Division of Science Resources Studies (SRS) by the Government Studies Group (GSG) staff: Beverly Fleisher, John Tsapogas, Margaret Meredith, and Richard Bennof. Elizabeth Michael and Steve Lowe, both of SRS, provided assistance in the preparation of this report. Supervision, review, and guidance were provided by Margaret Grucza, Study Director, GSG, Daniel Melnick, Acting Division Director, SRS, and Gerard Glaser, Director of Operations and Analysis, Directorate for Scientific, Technological, and International Affairs.

The GSG staff would like to thank the many program and budget officers at the agencies who provided information for this report.

CONTENTS

Notes to the Reader iii

Research and Development in the 1991 Budget 1

National Defense 10

Health 21

Space Research and Technology 33

General Science 47

Energy 67

Natural Resources and Environment 84

Transportation 94

Agriculture 99

Education, Training, Employment, and Social Services 104

International Affairs 109

Veterans Benefits and Services 110

Commerce and Housing Credit 112

Community and Regional Development 113

Administration of Justice 114

Income Security 115

General Government 116

Appendix: Historical Tables 117

The data in this report, with a few noted exceptions, are based on budget authority. Fiscal years are used throughout the report unless otherwise noted. The budget authority numbers are presented in millions of current dollars and rounded to the nearest million. Percent changes are computed using unrounded numbers. Details in tables may not add to totals because of rounding.

RESEARCH AND DEVELOPMENT IN THE 1991 BUDGET

Federal research and development funding serves two purposes: to meet the direct needs of the Federal Government where the supporting agencies are also the principal users of the results, and to assist in meeting broad national needs, particularly where the private sector lacks sufficient incentives to invest in research and development programs that will ensure continued long-term economic growth and maintenance of national competitiveness. R&D activities are conducted by almost every agency within the Federal Government. Both the level of funding and the proportion of budget authority that goes toward research and development varies widely among agencies and across budget functions. (See "Notes to the Reader" for an explanation of budget concepts and terms.)

Overview

The proposed budget authority for all Federal research and development programs in 1991 is $68.3 billion, an increase of 7 percent over the 1990 level of $63.8 billion. Budget authority for research and development grew less than 3 percent between 1989 and 1990. The proposed rise in R&D funding in 1991 reflects the administration's view that a strong base is necessary to support the Nation's preeminence in science and technology.

Funding for R&D is growing faster than the Federal budget as a whole, which is proposed to rise by 4 percent in 1991. R&D will maintain the pattern of the past 15 years when, with few exceptions, it has comprised approximately 5 percent of total Federal budget authority. R&D funding will, however, continue to grow as a proportion of the total budget for the budget functions that include R&D. The 7-percent proposed increase for R&D is double the proposed growth of total funding for the budget functions that contain R&D. In 1989, R&D accounted for less than 8 percent of the budget authority for these functions; in 1991 it is proposed to grow to 9 percent.

Defense-related R&D funding is proposed to be $41.4 billion in 1991, a 4-percent increase over estimated 1990 levels. This proposed increase reverses the decline of 2 percent in budget authority for defense-related R&D between 1989 and 1990. Civilian R&D funding is anticipated to grow by more than 12 percent to $26.9 billion in 1991. Civilian-related activities represent over 39 percent of Federal funding for the conduct of R&D. The proportion of R&D funds proposed for defense-related activities has declined almost two percentage points from 1990, from 62.5 percent to 60.7 percent.

When adjusted for inflation, funding for R&D is proposed to increase by nearly 3 percent over 1990, reversing the decline of 1.5 percent between 1989 and 1990. The decrease in constant dollar funding for R&D between 1989 and 1990 was partially driven by a continuing decline in enacted funding levels for national defense. R&D funding within the national defense function will continue to decrease in real terms in the proposed 1991 budget. The proposed real decrease in defense-related R&D budget authority is offset by a real increase of 8 percent in proposed funding of civilian R&D in 1991. (See appendix tables for historical trends.)

The five largest budget functions with respect to research and development -- national defense, health, space research and technology, general science, and energy -- together account for nearly 93 percent of all proposed Federal R&D funding. Four of the top five functions are proposed to receive increased funding for research and development in 1991; funds for energy R&D are slated to decrease.

The President's budget calls for total funding for basic research to rise by 9 percent to $12.4 billion in 1991. Basic research is proposed to receive over 18 percent of total R&D funds. The top five R&D functions account for over 89 percent of basic research funding. The Federal Government has traditionally played a key role in supporting basic research. Under the proposed budget, the percent growth in basic research funding will exceed increases in overall research and development funding. This continues the recent trend toward a greater proportion of R&D budget authority directed toward basic research.

Federal R&D budget authority by budget function
[Dollars in millions]

Rank		1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
	Total	$62,115	$63,805	$68,278	7.0%
1	National defense	40,642	39,877	41,421	3.9
2	Health	7,773	8,358	8,793	5.2
3	Space research and technology	4,555	5,577	7,556	35.5
4	General science	2,373	2,499	2,813	12.6
5	Energy	2,419	2,911	2,761	-5.1
6	Natural resources and environment	1,255	1,362	1,408	3.4
7	Transportation	1,064	1,144	1,342	17.3
8	Agriculture	907	949	1,010	6.4
9	Education, training, employment, and social services	347	390	410	5.1
10	International affairs	279	212	219	3.3
11	Veterans benefits and services	212	215	201	-6.7
12	Commerce and housing credit	128	139	158	14.1
13	Community and regional development	74	77	100	29.4
14	Administration of justice	45	44	45	1.1
15	Income security	27	35	26	-25.0
16	General government	15	17	17	0.0

SOURCE: National Science Foundation, SRS

Highlights of funding for R&D in the 1991 budget proposal are summarized below by budget function:

- National defense R&D funding is proposed to rise by $1.5 billion, or almost 4 percent above 1990 levels. This increase in funding will allow for modest growth in all mission areas in the Department of Defense (DOD) and in some Department of Energy (DOE) atomic energy defense activities. Major increases in funding will go to the Defense Agencies for Strategic Defense Initiative-related R&D and to the Department of the Army for anti-satellite weapons. The Department of Energy's environmental restoration and waste management activities are being reorganized and proposed to receive additional funding.

- Health R&D programs are anticipated to increase 5 percent to $8.8 billion. R&D programs for all components of the National Institutes of Health, the Centers for Disease Control, and the Alcohol, Drug Abuse, and Mental Health Administration will receive greater support. Over $1 billion is proposed for R&D on AIDS/HIV within the five Public Health Service agencies conducting work in this area. An 8-percent increase is proposed for NIH's Human Genome Project. Consumer and occupational health and safety programs' R&D funding will grow almost 14 percent.

- Space research and technology R&D program funding is scheduled to grow by 36 percent to $7.6 billion. A total of $2.3 billion is proposed for Space Station Freedom, the National Aeronautics and Space Administration's (NASA) largest R&D program. The space science program is proposed to receive $1.9 billion, to be distributed among several programs. Major increases are scheduled for R&D activities related to the Human Exploration Initiative. The budget also proposes that NASA receive $235 million for a new initiative, the Earth Observing System, as a major component of "Mission to Planet Earth."

- General science research funds are slated to increase nearly 13 percent to $2.8 billion. The growth in funding is attributable to the return to a path that would achieve a doubling of the National Science Foundation's (NSF) budget in 1993 over the 1987 level, and renewed research efforts in support of the Superconducting Super Collider. All NSF research directorates will receive additional funding with total budget authority for NSF research support proposed to grow by 12 percent. Major increases are directed toward the global geosciences program, the focus of NSF's contribution to the U.S. Global Change Research Program, and funding for science and technology centers. The Department of Energy's research budget is proposed to grow by 13 percent with increases in all programs.

- Energy R&D funding is scheduled to decline by over 5 percent to $2.8 billion in 1991. The decrease is attributable to reduced support for fossil energy and energy conservation programs at DOE and an overall reduction in the energy-related R&D programs of the Environmental Protection Agency (EPA). These reductions will be partially offset by greater funding for R&D programs supporting technical analysis, biological and environmental research, and solar and other renewable energy resources.

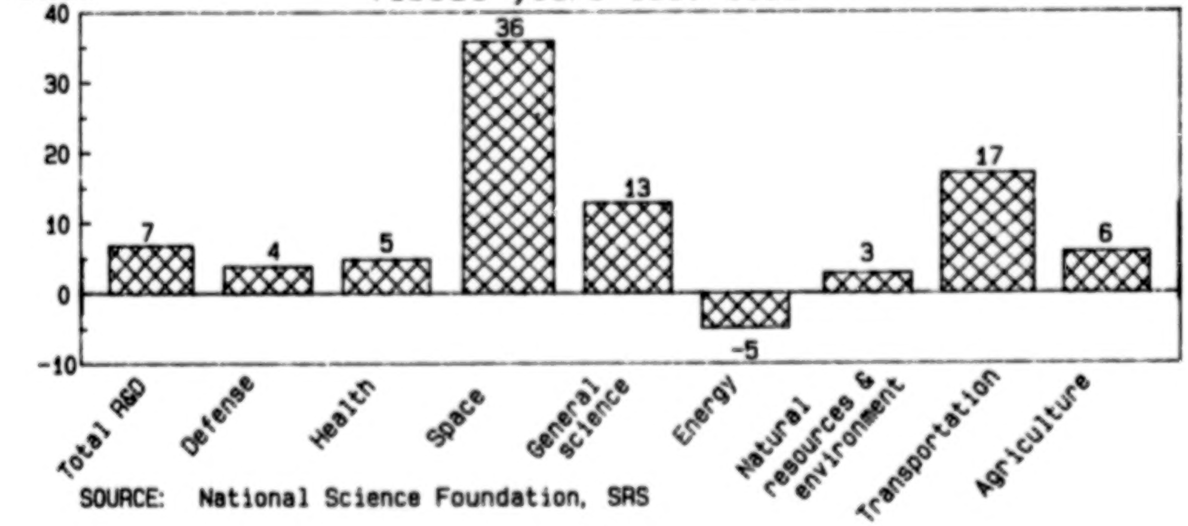
- Natural resources and environment's R&D funding is slated to increase over 3 percent to $1.4 billion. EPA is proposed to receive an additional $40 million primarily for air quality and interdisciplinary R&D. Both the Bureau of Reclamation and Army Corps of Engineers are proposed to have significant growth in funding for water-resources related R&D.

- Transportation funding for research and development is proposed to increase by 17 percent to $1.3 billion. The growth is largely attributable to air transportation activities including NASA's systems technology programs and the National Aerospace Plane Project. R&D for ground transportation is also proposed to increase significantly.

- Agriculture is proposed to have funding for its R&D activities increase by over 6 percent to $1 billion. Several initiatives, including the National Research Initiative, the Food Safety Initiative, the Water Quality Initiative, and the Global Change Initiative are all major recipients of funds. Additional R&D funding will be directed toward strengthening R&D activities at the 1890 land-grant institutions.

- When combined, the remaining 8 functions, each with less than $500 million in R&D budget authority, will increase more than 4 percent to $1.2 billion. Research and development in community and regional development is slated to increase over 29 percent and commerce and housing credit will increase by 14 percent. Education R&D programs are proposed to grow by 5 percent, international affairs programs by over 3 percent, and justice R&D by 1 percent. General government R&D program funding will remain constant. Income security R&D will decline by 25 percent and veterans benefits will decrease by approximately 7 percent.

Percent changes in major R&D budget functions: fiscal years 1990-1991



SOURCE: National Science Foundation, SRS

R&D's Share of Total Budget Authority

For functions which include R&D activities, the proportion of total budget authority scheduled for R&D varies greatly, from a high of 85 percent for energy to less than one-tenth of one percent for income security. While remaining steady as a proportion of the total Federal budget, R&D funding will continue to grow as a proportion of total funding for the functions in which research and development is conducted, rising to almost 9 percent in 1991.

Only two functions besides energy -- general science, and space research and technology -- have over 50 percent of their total funds directed toward research and development. Health and defense follow, each with 14 percent of funds proposed for R&D. Of the remaining 11 functions, all of which have less than 10 percent of their total budget allocated to R&D, four have 1 percent or less.

The proportion of a function's budget authority directed toward R&D can be affected by factors in addition to actual R&D funding. For example, it

R&D budget authority as a percent of each function's total budget authority

Rank		1989 actual	1990 estimated	1991 proposed
	All functions conducting R&D.......	7.9%	8.3%	8.6%
5	National defense.......................	13.6	13.2	13.5
4	Health.................................	15.0	13.9	13.6
3	Space research and technology...........	45.1	48.9	53.3
2	General science........................	83.2	78.0	76.5
1	Energy.................................	59.5	51.9	84.9
6	Natural resources and environment.......	7.4	8.0	8.0
8	Transportation.........................	3.6	3.7	4.4
7	Agriculture............................	4.3	5.3	5.0
12	Education, training, employment, and social services.................	0.9	1.0	1.0
10	International affairs..................	1.6	1.1	1.1
13	Veterans benefits and services..........	0.7	0.7	0.6
11	Commerce and housing credit............	0.2	0.7	1.1
9	Community and regional development......	0.9	0.9	1.4
14	Administration of justice..............	0.5	0.4	0.4
16	Income security........................	+	+	+
15	General government.....................	0.1	0.2	0.1

+ Less than one-tenth of one percent.

SOURCE: National Science Foundation, SRS

is proposed that the 1991 funding for R&D in the energy function decline by over 5 percent. R&D as a proportion of the function's total budget is proposed to change dramatically, from 52 percent in 1990 to 85 percent in 1991. This is attributable to a 42-percent decline in total budget authority for the energy function. Therefore, even though energy-related R&D is declining in absolute terms, total funding for the function is dropping dramatically, leading to an increase in the proportion of budget authority for R&D. In contrast, the agriculture function's total budget authority is increasing (12 percent) more than the budget authority for R&D (6 percent), leading to a decline in the proportion of the function's budget authority directed toward R&D.

Distribution of Total R&D Budget Authority Among Functions

In 1991, the five leading R&D functions -- national defense, health, space, general science, and energy -- account for 93 percent of all proposed Federal budget authority directed toward R&D. Natural resources and environment, transportation, and agriculture each account for between one and three percent of Federal Funding of R&D. The remaining eight functions each comprise less than one percent of total Federal funding of R&D.

Distribution of total R&D budget authority by function
(in percentages)

Rank		1989 actual	1990 estimated	1991 proposed
	Total	100.0%	100.0%	100.0%
1	National defense	65.4	62.5	60.7
2	Health	12.5	13.1	12.9
3	Space research and technology	7.3	8.7	11.1
4	General science	3.8	3.9	4.1
5	Energy	3.9	4.6	4.0
6	Natural resources and environment	2.0	2.1	2.1
7	Transportation	1.7	1.8	2.0
8	Agriculture	1.5	1.5	1.5
9	Education, training, employment, and social services	0.6	0.6	0.6
10	International affairs	0.4	0.3	0.3
11	Veterans benefits and services	0.3	0.3	0.3
12	Commerce and housing credit	0.2	0.2	0.2
13	Community and regional development	0.1	0.1	0.1
14	Administration of justice	0.1	0.1	0.1
15	Income security	+	0.1	+
16	General government	+	+	+

+ Less than one-tenth of one percent.

SOURCE: National Science Foundation, SRS

National defense research and development has declined from a high of 69 percent of Federal budget authority directed to R&D in 1986 to a proposed 61 percent in 1991. Despite this decline, defense is proposed to receive almost five times the budget authority for R&D than the next largest function, health. Health and energy's proportions of the budget authority directed to R&D also are smaller in 1991 than in 1990. Both space and general science are proposed to receive a larger proportion of total budget authority directed toward R&D than in 1990. Space's increase is dramatic, rising from 7 percent of total budget authority directed toward R&D in 1989 to 9 percent in 1990 to a proposed 11 percent in 1991. This growth in share largely is attributable to proposed funding for R&D for Space Station Freedom, the Human Exploration Initiative, and "Mission to Planet Earth."

Basic Research

The requested budget authority for basic research for all functions is $12.4 billion in 1991, 9 percent more than in 1990. The rate of growth in basic research will exceed that of total R&D between 1990 and 1991. Basic research as a proportion of R&D has increased from 17 percent in 1989 to a proposed 18 percent in 1991.

The top five research and development functions -- health, general science, space, defense, and energy -- are also the five largest basic research functions and account for over 89 percent of basic research funding. They are followed by agriculture, natural resources and environment, and transportation, which together account for 9 percent of basic research funding. The remaining 8 functions combined receive a total of more than 1 percent of the Federal budget authority directed toward basic research.

Only two functions have more than 50 percent of their research and development budget authority directed to basic research. These functions are general science, with 95 percent and health, with 57 percent of R&D budget authority used for basic research.

Health accounts for over 40 percent of all Federal basic research but only 13 percent of total Federal research and development. Funding for health basic research is anticipated to rise 6 percent to $5.0 billion in 1991.

General science function basic research funding is 22 percent of all Federal funds for basic research. Ninety-five percent of all general science R&D funds are allocated to basic research. Basic research budget authority for general science will grow 12.5 percent to $2.7 billion. Although it is among the top five functions for both total R&D funding and basic research funding, general science will receive only 4 percent of Federal R&D funds in 1991.

Space research and technology is expected to account for 13 percent of all basic research funding. This is a slightly larger share than the 11 percent of total R&D funds received by the function. Basic research funding will increase 21 percent to $1.6 billion in 1991. As a result of the large increase in total R&D budget authority proposed for space research and technology, however, basic research will decline as a proportion of R&D activities in this function, down to 21 percent from 23 percent in 1990.

National defense accounts for only 8 percent of Federal basic research but 61 percent of total Federal research and development. At $994 million, the proposed budget authority for basic research will be 2 percent of national defense's total funding of R&D. Although the level of funding for defense basic research has increased slightly from 1990 levels, defense will account for a smaller proportion of total Federal basic research activities than in 1990.

Energy is slated for $847 million, or 7 percent, of Federal R&D funds directed toward basic research. This represents an increase in the level of funding over 1990, but a drop in the share of total Federal basic research budget authority. As a percent of energy R&D funding, basic research has grown from 27 percent in 1990 to 31 percent in 1991.

Budget authority for basic research by budget function
[Dollars in millions]

Rank		1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
	Total	$10,648	$11,400	$12,384	8.6%
4	National defense	965	939	994	5.8
1	Health	4,413	4,714	4,993	5.9
3	Space research and technology	1,099	1,284	1,554	21.0
2	General science	2,265	2,384	2,683	12.5
5	Energy	703	797	847	6.2
7	Natural resources and environment	331	376	384	2.2
8	Transportation	287	288	270	-6.3
6	Agriculture	433	452	487	7.7
9	Education, training, employment, and social services	92	99	112	12.8
15	International affairs	3	5	2	-69.8
11	Veterans benefits and services	16	16	15	-6.8
10	Commerce and housing credit	29	29	33	12.4
13	Community and regional development	3	3	3	-23.5
12	Administration of justice	7	9	6	-31.5
16	Income security	0	0	0	0.0
14	General government	3	3	3	0.0

SOURCE: National Science Foundation, SRS

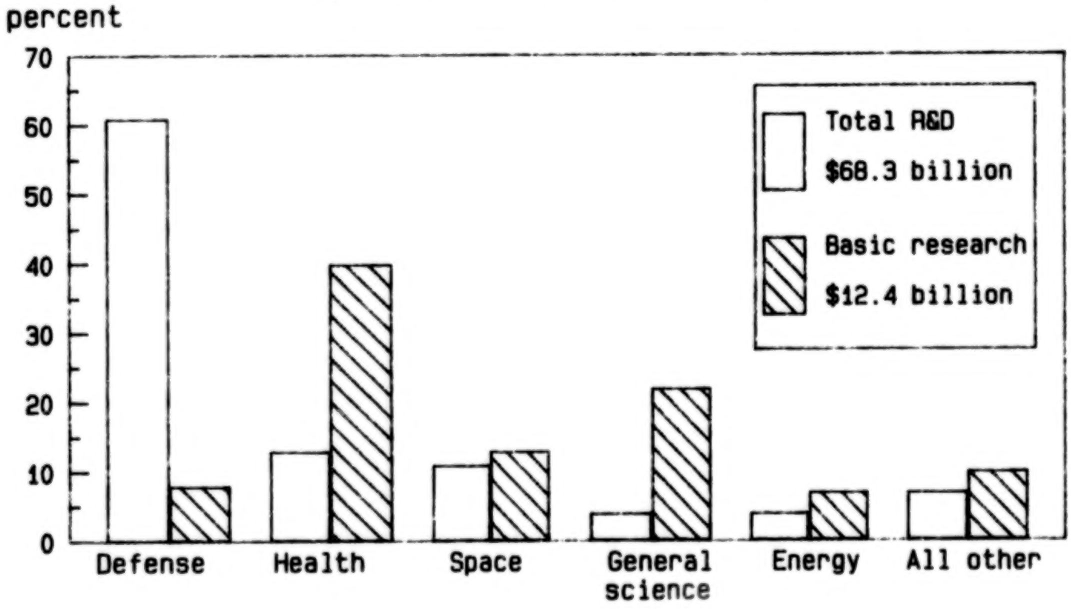
Agriculture accounts for 4 percent of Federal basic research funds. In 1991, 48 percent, or $487 million, of agriculture's R&D budget authority is allocated to basic research. Despite an increase in the level of funding, agriculture's share of Federal basic research funds will decline slightly from 1990.

Natural resources and environment will experience a small increase in the amount of basic research funds but a slight decrease in its share of total Federal basic research funds, keeping the function at 3 percent of the total. Of the function's R&D budget authority, $384 million, or 27 percent, is expected to be allocated to basic research.

Transportation is slated to receive 2 percent of Federal funds directed toward basic research. At $270 million, basic research comprises 20 percent of transportation's R&D budget authority. Both the level of funding for basic research and transportation's share of Federal basic research activities are lower than in 1990. In addition, basic research's proportion of total R&D funds within the transportation function is shrinking even as total R&D funds for the function are growing.

The remaining 8 functions in total account for more than 1 percent of Federal budget authority directed toward basic research. Many conduct virtually no basic research. Because of the low levels of funding for basic research in each of these functions, initiation or elimination of small projects can cause wide swings from year to year in the proportion of Federal basic research funds, level of funds, and proportion of the function's total R&D budget authority allocated to basic research.

Distribution of total R&D and basic research by major function: FY 1991



SOURCE: National Science Foundation, SRS

NATIONAL DEFENSE

Research and development activities within the national defense function (function 50) are funded by the Department of Defense's (DOD) research, development, test, and evaluation programs and the Department of Energy's (DOE) atomic energy defense programs. Defense research and development activities are designed to enhance both conventional and nuclear defense capabilities.

The national defense function is proposed to receive $41.5 billion in research and development funds in 1991, a 4-percent increase over 1990 funding. The Department of Defense's R&D activities account for 93 percent of national defense R&D funds. The remaining 7 percent is for the Department of Energy's atomic energy defense research and development activities. Defense R&D is slated to receive 61 percent of total Federal R&D funding in 1991, continuing the decrease in share that began in 1987.

Although overall defense R&D budget authority is scheduled to increase in 1991, the funding request does include reductions in some areas. Major changes proposed for R&D funding in 1991 are highlighted below.

- R&D funds for all of DOD's mission areas are proposed to increase in 1991, ranging from 0.3-percent growth in funding for tactical programs to a 9-percent increase for defensewide mission support.
- The Defense Agencies and the Department of the Army are proposed to receive more funding for R&D; the Departments of the Air Force and Navy are proposed to receive reduced R&D funding.
- Requested funding for advanced technology development R&D is 8 percent or $459 million greater than 1990 levels. This growth is attributable to the Defense Agencies' funding of multiple aspects of the Strategic Defense Initiative.
- The 5-percent increase in funding for DOD strategic programs is attributable to a proposed $453 million rise in Defense Agencies' funds for the air defense initiative and verification technology demonstration, and the Department of the Army's $110 million growth driven by increased funds for anti-satellite weapons.
- R&D funding for the V-22A Osprey tilt-rotor aircraft is proposed for termination. Other specific programs proposed to receive reduced R&D funding include the following: the P-3 modernization program, the forward area air defense system, advanced anti-submarine warfare, the B-2 advanced technology bomber, and the Trident II missile.
- The request for DOE's atomic energy defense R&D funding, at $2.8 billion in 1990, is 2-percent more than the 1990 level. Three of the seven programs are proposed for additional funding: weapons research, development and testing will grow by 4 percent; naval reactors development will increase 3 percent; and defense-related R&D activities of DOE's reorganized environmental restoration and waste management program will rise 12 percent.

R&D budget authority for national defense

[Dollars in millions]

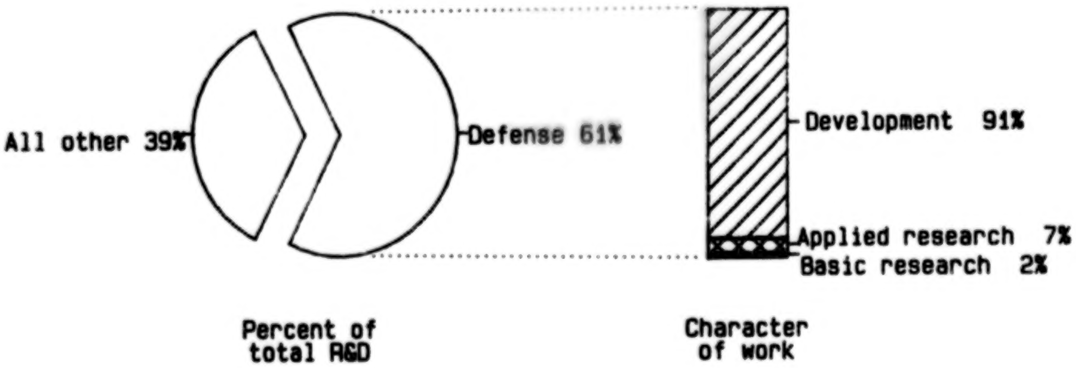
	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$40,665	$39,923	$41,470	3.9%
Department of Defense - military	38,031	37,226	38,714	4.0
Research, development, test and evaluation 1/	37,506	36,718	38,093	3.7
Department of the Air Force	14,668	13,497	13,276	-1.6
Defense Agencies	8,402	8,336	9,688	16.2
Department of the Navy	9,282	9,466	9,102	-3.8
Department of the Army	5,154	5,419	6,026	11.2
Other 2/	526	508	621	22.3
Department of Energy - atomic energy defense activities	2,633	2,697	2,756	2.2

1/ Data for the RDT&E request are available only in total obigational authority (TOA) which is the sum of new budget authority, unobligated budget authority from previous years, and other authorized credits.

2/ Adjustment to RDT&E budget to exclude major construction and add appropriate personnel costs in direct support of conduct of RDT&E.

SOURCE: National Science Foundation, SRS

R&D budget authority for defense: 1991



SOURCE: National Science Foundation, SRS

Department of Defense - military activities

The Department of Defense's research and development programs support the improvement of equipment, intelligence, and personnel for the Nation's defense. The Departments of the Air Force, Army, and Navy, and the Defense Agencies work individually and together to support six R&D areas: (1) defense technology base, (2) advanced technology development, (3) tactical programs, (4) strategic programs, (5) intelligence and communications, and (6) defensewide mission support.

Funding for DOD's R&D programs is proposed to grow by less than 4 percent to $39 billion in 1991. All of the mission areas are slated for growth in funding although some of the increases will not keep pace with inflation. Within the overall total, the Defense Agencies and the Department of the Army will receive increases in R&D funds. The Departments of the Air Force and Navy are proposed to have decreases in funding of R&D. The Department of the Air Force will maintain its position as the recipient of the largest share of DOD R&D funds in 1991.

Tactical programs

Tactical programs provide for the enhancement of capabilities of conventional and nuclear forces. Tactical programs are proposed to receive less than a 1-percent increase in funding, to $13.5 billion in 1991. The Departments of the Navy and Air Force will receive fewer funds while the Department of the Army and the Defense Agencies will receive more support.

The budget request for the Department of the Navy's tactical programs is 6 percent lower than in 1990. There is a proposed reduction in support for the P-3 modernization program and R&D funds for the V-22A Osprey tilt-rotor aircraft are proposed for termination. The budget proposes continued work on the advanced tactical fighter, the advanced air-to-air missile, submarine systems including the SSN-21 submarine, advanced nuclear power systems, early warning systems, anti-submarine warfare abilities, Marine Corps assault vehicles, upgrading the F-14, and the F/A 18 squadrons.

Overall funding for the Department of the Air Force's tactical programs R&D is slated to decline by 3 percent. The C-17 transport aircraft and F-111 squadron programs will be continued at reduced levels. The Air Force plans to continue funding for the advanced tactical fighter, F-15E, and airborne warning and control systems (AWACS) at constant or slightly higher levels. Funding for the joint surveillance/target attack radar system (JSTARS), F-16, and short range attack missile (SRAM-T) will be significantly enhanced. Electronic warfare development program funding will more than double from the 1990 level.

The Department of the Army's R&D activities in tactical programs will have a 14-percent increase in funding. Funding for the light armed scout helicopter is proposed to increase 84 percent to $411 million. Engineering development for the fiber optic guided missile and the sense and destroy armament missile will continue at reduced levels. The M1A1 tank development program will be initiated. Funds for the advanced anti-tank weapons systems will decline and the forward area air defense system program will no longer be funded.

Total obligational authority for DOD research, development, test, and evaluation budget 1/

[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$37,506	$36,718	$38,093	3.7%
Tactical programs	12,989	13,446	13,481	0.3
Department of the Navy	6,037	6,523	6,146	-5.8
Department of the Air Force	4,067	3,885	3,777	-2.8
Department of the Army	2,691	2,683	3,060	14.0
Defense Agencies	194	355	497	40.2
Advanced technology development	5,837	5,858	6,317	7.8
Defense Agencies	4,459	4,491	4,986	11.0
Department of the Air Force	758	639	646	1.1
Department of the Army	430	514	485	-5.7
Department of the Navy	190	214	200	-6.7
Strategic programs	6,428	5,364	5,609	4.6
Department of the Air Force	5,334	4,475	4,262	-4.8
Defense Agencies	245	312	765	145.2
Department of the Army	70	186	296	58.9
Department of the Navy	778	391	286	-26.9
Intelligence and communications	4,512	4,779	4,957	3.7
Department of the Air Force	2,057	2,124	2,265	6.6
Defense Agencies	1,678	1,694	1,723	1.7
Department of the Navy	723	860	874	1.6
Department of the Army	54	101	95	-5.2
Defensewide mission support	4,234	3,944	4,294	8.9
Department of the Air Force	1,668	1,618	1,544	-4.6
Department of the Army	1,168	1,205	1,321	9.7
Department of the Navy	770	673	730	8.4
Defense Agencies	628	448	699	56.2
Technology base	3,506	3,327	3,435	3.3
Defense Agencies	1,197	1,037	1,017	-1.9
Department of the Navy	782	805	867	7.8
Department of the Air Force	785	755	782	3.5
Department of the Army	742	729	769	5.4

1/ Detailed budget information on DOD R&D activities is only available in total obligational authority (TOA) for RDT&E.

SOURCE: National Science Foundation, SRS

R&D funding for the Defense Agencies' tactical programs is proposed to grow by 40 percent to $497 million. Most of this rise is due to a $36 million increase in funding for the joint standoff weapons program and the proposed initiation of a $182 million active force enhancement program.

Advanced technology development

In the proposed budget, advanced technology development R&D funds are scheduled to rise 8 percent in 1991, to $6.3 billion. This increase is attributable to funding of multiple R&D aspects of the Strategic Defense Initiative (SDI) through the Defense Agencies which will receive an 11-percent increase for advanced technology base R&D support. The Department of the Air Force is slated for growth of 1 percent. These increases are partially offset by proposed 6- and 7-percent decreases in funding for the Departments of the Army and Navy.

Additional support will be given to SDI-related research in surveillance, acquisition, tracking and kill assessment, directed and kinetic energy weapons, and systems and battle management. Funding for materials research and electronics through the Defense Agencies' microwave/millimeter wave monolithic integrated circuits (MIMIC) program will increase slightly. Support for the balanced technology initiative will remain stable. SEMATECH, a private sector consortium formed to conduct R&D on improved semiconductor manufacturing processes, will be supported by DOD at the same level as in 1990, $100 million. This represents approximately half of the consortium's funding, with the balance provided by the consortium participants.

Department of the Air Force support for the national aerospace plane technology program, conducted in conjunction with the National Aeronautics and Space Administration, is proposed to decline $44 million from the 1990 level to $158 million. (NASA's funding for the national aerospace plane is contained in the transportation function.) Other aspects of advanced avionic systems and aerospace vehicle technology are proposed to receive more funding.

Although the Department of the Army's overall funding for advanced technology development is proposed to decline, funds for R&D related to combat vehicle and automotive advanced technology are proposed to grow by 48 percent. The Department of the Navy will see across-the-board reductions in most projects with substantial cuts in advanced anti-submarine warfare technology and advanced technology transition programs.

Strategic programs

Funding for R&D in strategic programs is proposed to increase almost 5 percent to $5.6 billion. The Department of the Air Force, the recipient of the majority of strategic programs' R&D funds, will have funding cut by 5 percent and the Department of the Navy will receive 27 percent fewer funds. These declines are offset by the Defense Agencies, slated for funding growth of 145 percent, and the Department of the Army, proposed to receive a 59-percent increase.

Although it continues to be a major program, support for the Department of the Air Force's R&D for the B-2 advanced technology bomber is proposed to decline from $1.9 billion in 1990 to $1.6 billion in 1991. Funding for engineering development on the short range attack missile II (SRAM II), and ICBM modernization is also proposed for reduction. Support for advanced strategic missile systems, the advanced cruise missile and Minuteman squadrons will rise. Total R&D funding for Milstar satellite communications systems will grow by 26 percent to over $769 million.

The Defense Agencies' R&D funds for strategic programs will increase 145 percent, in large part because of initiation of Phase I of the strategic defense system. Other areas of proposed funding growth are the air defense initiative and verification technology demonstration.

Department of the Army strategic programs R&D is proposed to grow $110 million from the 1990 level. Decreases in other programs are offset by a $134 million increase for the anti-satellite weapon (ASAT) program.

Total strategic program R&D funding for the Department of the Navy is proposed to decrease by 27 percent. Among the anticipated reductions are a 57-percent decline in funding for the Trident II missile and fewer funds for R&D on fleet ballistic missile systems, strategic communications, and command and control information systems. These declines are partially offset by general increases in other programs and a new initiative in submarine acoustic warfare development.

Intelligence and communications

Funding for R&D in intelligence and communications is proposed to grow 4 percent, to $5 billion, in 1991. R&D activities are directed toward improving defense intelligence and command and control systems. Efforts include the improvement of threat warning and surveillance sensors through the use of advanced signal processing technology. Also proposed is continued work on satellite communication, surveillance radars, thermal imagers, and infrared search and track system.

In addition to other intelligence and communications activities, the Departments of the Air Force, Navy, and Army will continue to support research and development for the NAVSTAR global positioning system at approximately $120 million.

The proposed funding for Defense Agencies' R&D in this area will include an additional $93 million in funding for the airborne reconnaissance support program, raising the total for that program to $180 million. At a proposed $225 million, the Defense Mapping Agency's mapping, charting, and geodesy production system improvement program will continue to receive high levels of funding.

Defensewide mission support

The budget proposes 9-percent growth in defensewide mission support R&D, which would raise it to $4.3 billion in 1991. This program provides R&D support for ranges and test facilities, and research and development activities related to improving instrumentation and methods for hardware test and evaluation capabilities. Research and development will continue on the use of technology to reduce manufacturing costs and to extend the life and capabilities of existing defense systems.

The Departments of the Army and Navy and the Defense Agencies are all slated to receive increased funding for defensewide mission support. The majority of funding for the services is devoted to the conduct of test and evaluation activities, maintenance of existing test and evaluation capacity, and instrumentation upgrades at test ranges and facilities. Funding for the services' defensewide mission support activities is proposed for a $99 million, or less than 3-percent, overall increase.

The Defense Agencies' funding includes support of the Office of the Deputy Director of Defense Research and Engineering (Test and Evaluation) which is responsible for approving projects' progression from the advanced development stage into engineering development. Funds for test instrumentation development are proposed to increase by $101 million to $186 million in 1991; funds in support of conduct of development, test, and evaluation are proposed to increase by $69 million to $120 million. An additional $78 million is proposed to expand the capability of the Office of the Director of Operational Test and Evaluation which is responsible for testing products of the RDT&E system in realistic environments before they are approved for full-scale production and acquisition.

Technology base

Technology base research funding is expected to grow 3 percent to $3.4 billion in 1991. The Defense Agencies' technology base activities are scheduled to decline by 2 percent while the services will all receive additional funding. Although many of the Defense Agencies' technology base programs will experience modest growth in funding, three areas -- strategic technology, integrated command and control technology, and materials and electronics technology -- are slated for reduced funding.

The Department of the Navy's funds are proposed to rise by nearly 8 percent, with small amounts of growth in all programs with the exception of anti-submarine warfare technologies. Electronic warfare programs are proposed to move from tactical programs to technology base. The Department of the Air Force is slated for a 4-percent increase in funds, spread evenly across programs with the exception of advanced weapons programs which will receive a 14-percent increase, and aerospace propulsion programs which will face declining support. The Department of the Army is scheduled to receive 5 percent more funds which are planned to be distributed evenly across technology base programs.

Department of Energy - atomic energy defense activities

In support of the administration's national security policies, defense R&D activities of DOE are focused on five broad missions: (1) support the national security policies of the United States for a reliable nuclear deterrent, including the long-term effort to develop new production reactor capacity, (2) provide safe and environmentally sound operations to assure continued production capability in the complex, (3) provide safeguards and security for nuclear weapons, devices, materials, facilities, and information under DOE control, (4) provide treaty verification, intelligence, and arms control support essential to national security and foreign policies, and (5) support the nuclear research and development effort essential to the U.S. Navy.

R&D funding for DOE's atomic energy defense activities is proposed to increase by 2 percent, to $2.8 billion, in 1991. Of these funds, 63 percent will be used to support weapons research, development, and testing. Requested funding for this program is $1.6 billion, 4-percent higher than the 1990 level. Naval reactors development is slated to increase 3 percent to $569 million, and environmental restoration and waste management is proposed to grow 12 percent to $184 million. The remaining four programs -- nuclear materials production, new production reactor, verification and control technology, and nuclear safeguards and security -- are slated for reductions in funding ranging from 1 to 15 percent.

R&D activities formerly conducted under the defense waste and environmental restoration program will, as part of DOE's five-year plan for environmental clean-up, be funded through the environmental restoration and waste management program.

R&D budget authority for DOE atomic energy defense activities
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$2,633	$2,697	$2,756	2.2%
Weapons research, development and testing	1,530	1,531	1,590	3.8
Naval reactors development	555	554	569	2.7
Nuclear materials production	219	228	225	-1.1
Environmental restoration and waste management	44	165	184	11.6
New production reactors	186	125	106	-15.1
Verification and control technology	59	57	50	-11.7
Nuclear safeguards and security	39	37	32	-13.8

SOURCE: National Science Foundation, SRS

Weapons research, development, and testing

R&D activities within the weapons research, development, and testing program are designed to meet several goals: (1) ensure the scientific and technological integrity of the national nuclear weapons stockpile, (2) develop producible weapons for the stockpile, (3) sustain an innovative technical base for ensuring future weapons capability, and (4) provide the scientific basis for avoiding technological surprise. R&D funds are proposed to increase 4 percent to $1.6 billion in 1991.

Proposed activities for 1991 include studies of the feasibility of three nuclear directed energy weapons technologies -- x-ray lasers, hypervelocity projectiles, and optical frequency lasers -- for use as part of the Strategic Defense Initiative. The focus in inertial fusion R&D is on determining the feasibility and affordability of a laboratory microfusion facility which could be used to advance weapons physics and also provide information useful in civilian electric power applications.

R&D activities will also continue on the development of safe secure systems for transporting nuclear weapons and weapon components. Weapons safety will receive renewed emphasis; efforts will be directed toward reducing the probability of accidental dispersal of radioactive materials. Research related to underground nuclear testing remains a high priority.

Naval reactors development

The naval reactors development program carries out nuclear propulsion development work essential to the U.S. Navy. R&D funds for this mission are anticipated to increase 3 percent to $569 million in 1991. Key thrusts of the naval reactors development budget are R&D for operating plant improvements, development of better components and systems for these plants, advanced fleet reactor development for the Seawolf class attack submarine, and advanced nuclear propulsion technology development.

Reactor development activities are expected to proceed on several fronts including the following: (1) techniques for examination of shipboard and prototype cores, (2) development of new, high integrity nuclear fuel, poison, cladding, and structural materials, (3) reactor physics development and nuclear design of advanced reactor cores, (4) development of methods to optimize the performance of all reactor components, individually and as a system, and (5) research on improvement of core manufacturing, assembly, and fabrication techniques. Plant development activities will focus on developing technology to operate and monitor plants and facilities, and developing, testing, and evaluating new plant configurations.

Nuclear materials production

The materials production program's primary mission is to meet weapons program requirements. In support of this goal, R&D efforts are focused on development of engineering improvements to address environmental protection and safety concerns, process optimization to maximize production at minimum unit cost, and development of alternative production methods. At this time, the program is not producing any new tritium or plutonium in its production reactors. Special emphasis is being given to R&D directed at identifying and correcting deficiencies that would prevent assurance of minimum risk to personnel, facilities, and the environment should production resume. R&D is focused on four principle reactor improvement objectives: (1) design bases and systems performance, (2) human performance, (3) management systems and practices, and (4) on-site technical oversight.

The budget proposal includes funds for implementing a closeout of the special isotope separation (SIS) R&D project because it was determined that the production capability for weapons grade plutonium that would have been provided by the SIS program is not currently justified in light of fiscal considerations. Funding for research and development in nuclear materials production is scheduled to decrease 1 percent to $225 million in 1991.

Environmental restoration and waste management

This program merges the atomic energy defense program's environmental activities with similar programs in energy research and nuclear energy in the energy function. Approximately 85 percent of the new environmental restoration and waste management program's R&D funding will be directed toward atomic energy defense-related issues, reflecting concerns with the environmental effects of nuclear materials and weapons production byproducts. The dollar amounts reported in this function reflect only that portion of the program that is defense-related. The remaining funds are reported under the energy function.

A 12-percent increase in funding to $184 million is proposed for the atomic energy defense-related portion of the program in 1991. The five year initiative has four major components -- technology development, waste operations, environmental restoration, and corrective activities. Technology development is an applied research, development, test, and evaluation initiative to support all environmental restoration and waste management activities. The objective of the program is to resolve major technical issues and rapidly advance newer technologies. Application of innovative technologies resulting from successful technology development has the potential to produce significant cost savings in other initiative components. For example, substitution of in-situ vitrification for excavation, treatment, and disposal would reduce the cost of environmental restoration.

New production reactors

The design and development of new production reactor capacity is required to produce nuclear materials, primarily tritium, to maintain the Nation's nuclear deterrent. Funding for new production reactors is proposed to decrease 15 percent in 1991 to $106 million. R&D efforts are being directed toward the development of methods to ensure that the primary considerations of safety, quality, environment, and performance factors are employed in the design, construction, and operation of new production reactors. The requested 1991 funding will be used to support several programs: (1) full compliance with the National Environmental Policy Act through the preparation of an environmental impact statement, (2) development of a safety review process, (3) technical assessments and reviews of key reactor components and systems, and (4) reactor technology development, including the development of safety and design criteria.

R&D is currently being conducted on three reactor technologies. Two preferred reactor technologies, a heavy water reactor facility, and a modular high-temperature gas-cooled reactor plant, are receiving increased attention. R&D on a less preferred, light water reactor technology is also proposed for continuation.

Verification and control technology

R&D funding for verification and control technology will decrease 12 percent to $50 million in 1991. The major R&D-related goals of the program include the following: (1) development of effective tools for on-site and in-country verification, (2) continuing development of next-generation satellite instrumentation for verification, (3) development of equipment and procedures to verify treaty compliance without compromising sensitive information at inspected DOE facilities, and (4) enhancement of the Department's ability to identify threats from a larger threat spectrum than current capabilities allow.

R&D priorities in 1991 include developing seismic and satellite tools for verification of nuclear testing and other arms control treaties, detecting directed energy and chemical weapons, and developing an infrastructure to support assessment of threats to domestic nuclear facilities and weapons. Research is also focused on analysis of arms control activities, both domestic and foreign, to provide technical support to decision makers in the arms control process.

Nuclear safeguards and security

The nuclear safeguards and security program is charged with developing measures to assure effective protection of DOE's nuclear weapons, materials, and facilities. The program also includes R&D in support of international safeguards and the International Atomic Energy Agency in fulfillment of U.S. nonproliferation policies and objectives. Funds for R&D activities will be $32 million in 1991, a 14-percent decrease from 1990. The proposed budget continues a shift in emphasis from protection against outsider adversary intrusions to a more balanced program that strengthens protection against insider threats.

Efforts will continue at a reduced funding level to improve nuclear material accounting including development of non-destructive assay, calorimetric, chemical, and isotropic analysis measurement methods and instruments. R&D for the national nuclear materials data base system, designed so that timely, accurate, and comprehensive safeguards and materials management data are available, also is proposed to continue at a reduced level of funding. Computer security research will continue at last year's level. Priority is given to the development of an integrated program for physical protection, material control, and material accountability.

HEALTH

All research and development in the health function (function 550) is funded by the Department of Health and Human Services (HHS) and the Occupational Safety and Health Administration within the Department of Labor. This function is divided into two broad categories: Health and consumer and occupational health and safety.

In 1991, the health function is proposed to receive $8.8 billion for research and development, an increase of $432 million, or 5 percent, over 1990 levels. Of this amount, $5 billion is proposed for basic research, representing 42 percent of total Federal basic research requested in 1991.

Research and development funding proposed in the 1991 budget for health provides growth for almost all R&D programs. Highlights of the most notable changes in health R&D programs are highlighted below.

- The National Institutes of Health (NIH) is proposed to receive $7.5 billion for research and development in 1991, an increase of $330 million or almost 5 percent.

- A total of $991 million is proposed for the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA), an increase of $94 million or 10 percent.

- A total of $1.0 billion is proposed for research and development on Acquired Immunodeficiency Syndrome/Human Immunodeficiency Virus (AIDS/HIV).[1] The request provides an overall increase of $84 million in the combined budgets of the five Public Health Service (PHS) agencies conducting or supporting research and development on AIDS/HIV.

- A total of $103 million is proposed for the NIH's Human Genome Project, an increase of $47 million or 82 percent. This program has been established as a new NIH component, the National Center for Human Genome Research.

- Four NIH programs aimed at increasing the participation of minorities in biomedicine are proposed to receive a total of $84 million, an increase of 17 percent over 1990.

- The 1991 request includes $39 million for the establishment of the Agency for Health Care Policy and Research, which includes activities formally undertaken by the Office of the Assistant Secretary for Health (OASH).

---

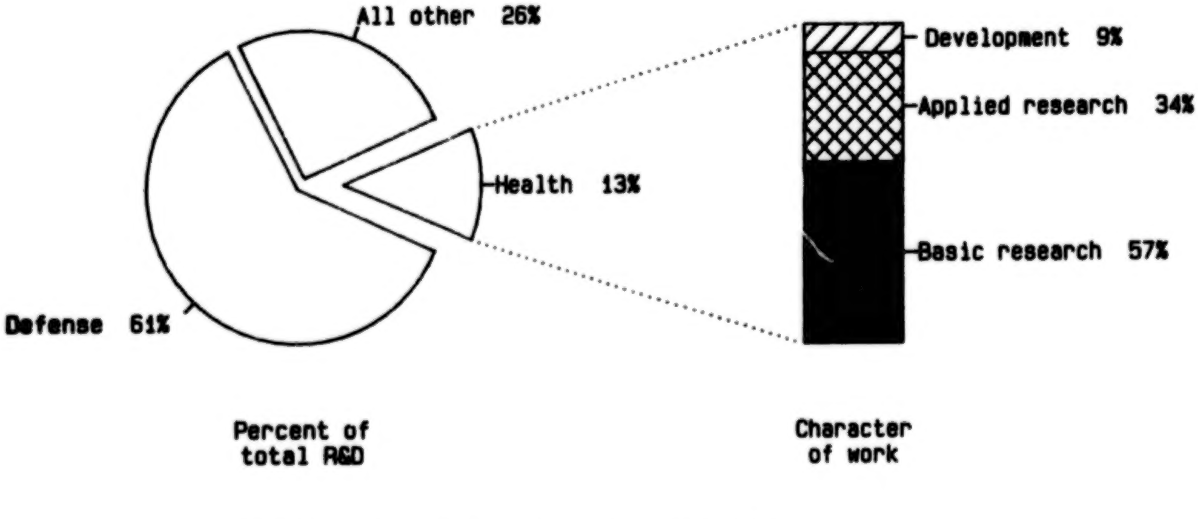
[1] The term AIDS/HIV is used to reflect the entire spectrum of R&D activities undertaken on AIDS and HIV, the etiologic agent that causes AIDS.

R&D budget authority for health 1/
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$7,773	$8,358	$8,793	5.2%
Health programs (HHS)	7,670	8,244	8,663	5.1
National Institutes of Health	6,776	7,140	7,470	4.6
Alcohol, Drug Abuse, and Mental Health Administration	729	897	991	10.5
Centers for Disease Control	118	126	131	3.9
Agency for Health Care Policy and Research	-	-	39	**
Health Care Financing Administration	10	13	13	0.8
Health Resources and Services Administration	10	10	10	0.0
Assistant Secretary for Health	27	57	8	-85.6
Indian Health Services	1	1	1	0.0
Consumer and occupational health and safety	103	114	130	13.6
Food and Drug Administration (HHS)	99	110	126	14.1
Occupational Safety and Health Administration (Labor)	4	4	4	0.0

1/ Funding includes AIDS/HIV.
** FY 1991 is the first year for which R&D funding is proposed.
SOURCE: National Science Foundation, SRS

R&D budget authority for health: 1991



SOURCE: National Science Foundation, SRS

In the following discussion, funding for research and development includes the amounts requested for AIDS/HIV R&D activities unless otherwise indicated. In 1991, there are four agencies of the Public Health Service (PHS) that have requested research and development funding for AIDS/HIV: the NIH, ADAMHA, the Centers for Disease Control (CDC), and the Federal Drug Administration. A summary of the proposed funding for AIDS/HIV research and development for these PHS agencies follows the overall discussion on health and occupational health and safety R&D programs (see page 30).

Health Programs

National Institutes of Health

The National Institutes of Health (NIH) is the principal biomedical research agency of the Federal government. It is the largest agency in the health function; in 1991, the NIH's proposed R&D funding comprises 95 percent of health research and development. Through support of biomedical and behavioral research both in the U.S. and abroad, the NIH seeks to improve the understanding of the processes underlying human health, disease, and disability and to develop new methods of preventing, detecting, diagnosing, and treating disease.

The NIH is proposed to receive $7.2 billion for research and development in 1991, an increase of $339 million or 5 percent over 1990 levels. Included in this funding is $775 million for AIDS/HIV, $56 million or 8 percent more than in 1990. Excluding AIDS/HIV, funding for research and development is proposed to grow by 4 percent. The 1991 request also includes a 5-percent increase in basic research (4 percent excluding AIDS/HIV), reflecting the Administration's commitment to fostering basic research.

Investigator-initiated research continues to be one of NIH's highest priorities. A total of $4.4 billion is requested for research project grants (RPGs), $227 million more than in 1990. This level will support a total 20,439 RPGs, a net increase of 123 over 1990 levels. The number of new and competing renewal awards is proposed to increase by 462 to 5,095, and includes an additional 26 awards for the Human Genome Program and 118 for AIDS/HIV. The average cost of these awards will increase by 2 percent in 1991. Because of the proposed reduction of 339 to 15,344 in the number of noncompeting continuations, the average cost of these awards will increase by 6-percent.

One component of extramural research and development receiving special attention in 1991 is NIH's minority programs, which are aimed at increasing the participation of minorities in biomedicine. Overall R&D funding for four minority programs, the Minority Access to Research Careers Program, the Minority Biomedical Research Support Program, the Minority High School Student Apprenticeship Program, and the Research Centers in Minority Institutions Program is proposed to increase by 17 percent over 1990 levels.

R&D budget authority for the National Institutes of Health 1/
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$6,776	$7,140	$7,470	4.6%
National Cancer Institute	1,533	1,592	1,655	4.0
National Heart, Lung, and Blood Institute	1,004	1,023	1,065	4.1
National Institute of Allergy and Infectious Diseases	725	813	869	6.9
National Institute of General Medical Sciences	605	595	657	10.5
National Institute of Diabetes and Digestive and Kidney Diseases	538	556	581	4.5
National Institute of Neurological Disorders and Stroke	459	476	498	4.8
National Institute of Child Health and Development	410	424	444	4.6
Division of Research Resources	351	351	317	-9.9
National Eye Institute	225	229	240	4.8
National Institute on Aging	214	229	239	4.1
National Institute of Environmental Health Sciences	214	218	225	3.2
National Institute of Arthritis and Musculoskeletal and Skin Diseases	153	162	169	4.7
National Institute of Dental Research	125	129	134	3.9
National Institute of Deafness and other Communicative Diseases	92	114	120	4.8
National Center for Human Genome Research	-	56	103	82.1
Office of the Director	65	101	77	-23.2
National Library of Medicine	24	28	31	10.6
National Center for Nursing Research	25	29	31	5.5
John E. Fogarty International Center	16	16	16	5.2

1/ Funding includes AIDS/HIV

SOURCE: National Science Foundation, SRS

In 1991, the proposed funding for research and development also includes $915 million for intramural research, another area receiving priority in NIH's budget. This growth provides a 7-percent increase in intramural R&D funding overall, which is distributed relatively evenly among the NIH components having intramural programs.

The following discussion highlights the proposed R&D funding in the 1991 budget for the five largest institutes. These five institutes comprise 65 percent of NIH's total research and development funding.

National Cancer Institute (NCI): The NCI supports clinical trials in treatment and prevention aimed at the improvement of diagnostic tools for the detection of cancer and of therapeutic and surgical methods for its treatment. The 1991 request includes $785 million for investigator-initiated research, representing an increase of 5 percent and nearly three-fourths of NCI R&D funding. This funding level will support 3,109 RPGs, including 2,294 noncompeting grants and 815 new and competing renewal awards. A total of $333 million is requested for intramural research, an increase of $18 million, and $103 million for NCI's 56 research centers, approximately the same funding level as in 1990.

Of NCI's proposed R&D funding, $161 million is for research and development on AIDS/HIV, $11 million more than in 1990. The NCI is the second largest participant in the NIH AIDS/HIV program. The 1991 request enables NCI to continue ongoing investigations on the mechanisms of HIV-1 infection, the factors suspected to allow infection to progress, and the influence of the immune response on the course of AIDS infection.

National Heart, Lung, and Blood Institute (NHLBI): The NHLBI conducts and supports R&D programs that include basic investigations, clinical trials, and educational programs related to the cause, diagnosis, treatment, and prevention of heart, lung, blood vessel and blood diseases. The 1991 request includes $702 million for RPGs, a 5-percent increase over 1990 levels. The proposed funding will support 718 new and competing renewal awards, 117 more than in the previous year. The number of continuing grants has been reduced by 121 to 2,057. Intramural funding is proposed to increase by 9 percent. The number and level of funding for NHLBI research centers is proposed to remain at 1990 levels.

NHLBI's request includes $44 million for research and development on AIDS/HIV. The NHLBI's AIDS/HIV program is divided into two major research areas: Transfusion transmitted HIV infection; and the hematologic, pulmonary, and cardiac complications arising from HIV infection. The 1991 request provides for continued efforts to define the natural history of lung disease in HIV-infected individuals and to improve our understanding of the mechanism by which Pneumocystis carinii results in respiratory failure.

National Institute of Allergy and Infectious Diseases (NIAID): This Institute conducts and supports research that seeks to improve our ability to prevent and control infectious diseases and diseases that result from disorders of the immune system. The 1991 budget request includes $552 million for RPGs, an increase of $35 million over 1990. This level will support a total of 2,204 RPGs compared to 2,096 in 1990. The number of RPGs includes 1,624 noncompeting grants and 580 new and competing renewal awards.

In addition, the proposed funding includes $22 million for NIAID's 28 research centers and $116 million for its intramural research program.

The NIAID is the lead institute for coordinating, conducting, and supporting the NIH AIDS/HIV program. A total of $422 million is proposed for AIDS/HIV research and development, almost half of NIAID's proposed R&D funding in 1991. This funding level provides an increase of $30 million over 1990 to expand NIAID's research on drug and vaccine development, clinical trials, and programs aimed at the needs of women and underrepresented populations.

National Institute of General Medical Sciences (NIGMS): The NIGMS supports extramural research in molecular genetics and gene expression. Research focuses on the relationships of structure to function in biological systems, such as the understanding of protein folding and the impact of membrane structure on the immune system. Investigator-initiated research is proposed to receive $584 million, a 22-percent increase over 1990 levels. The 1991 request supports a total of 3,200 RPGs comprised of 2,381 noncompeting grants and 819 new and competing renewal awards. This level includes an increase of 182 in the number of new and competing renewal awards and a concomitant reduction of 178 in the number of noncompeting grants. Also included in the request is $7 million to support the institute's 9 research centers.

Research and development on AIDS/HIV supported through NIGMS focuses on the structures of the proteins involved in the pathology of AIDS, including for example, the protein that covers and protects the AIDS virus as it travels through the bloodstream in search of a host cell. The 1991 request provides $10 million for AIDS/HIV research to continue six ongoing studies and to support studies in basic chemistry related to AIDS.

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDKD): The NIDDKD supports basic and clinical investigations that seek to increase the understanding of an extensive range of diseases including diabetes, other endocrine and metabolic diseases, and digestive, kidney, and urologic diseases. The institute also supports studies in endocrinology, nutrition, and hematology. The 1991 request proposes $422 million for investigator-initiated research, an increase of 5 percent. The number of new and competing renewal awards is proposed to increase by 72 to 495, while the number of noncompeting continuations is reduced by 73 for a total of 1,534 in 1991. The proposed funding also includes $73 million for intramural research and $34 million for the institute's 40 research centers.

The 1991 request includes $6 million for NIDDKD research and development on AIDS/HIV, about the same amount as in 1990. The NIDDKD sponsors and conducts research to develop anti-viral agents to fight AIDS, including the evaluation of dideoxycytidine (DDC) and azidothymidine (AZT). The institute is also conducting research to examine the three dimensional structure of both HIV and proteins of the human immune system.

Alcohol, Drug Abuse, and Mental Health Administration

The Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) is the lead Federal agency for research on mental illness and substance abuse disorders. Research and development conducted and supported by ADAMHA strives to seek solutions to the cause, treatment, and prevention of mental illness. In 1991, ADAMHA is proposed to receive $991 million, $95 million more than in 1990. Included in the 1991 request is $174 million for AIDS/HIV, an increase of $34 million over 1990 levels.

The 1991 request proposes $494 million for investigator-initiated research, representing nearly half of ADAMHA's request, to support 2,403 research project grants. The proposed number of RPGs includes 1,799 noncompeting continuing grants and 604 new and competing renewal awards. This level provides an increase of 329 continuing grants and a reduction of 195 in competing awards. The 1991 request includes $91 million to support 83 research centers, two more than in 1990. Intramural research is proposed to receive $126 million, $9 million more than in 1990.

National Institute of Mental Health (NIMH): The NIMH conducts and supports basic and clinical studies on the treatment and prevention of mental disorders. The 1991 request proposes $236 million for RPGs, $14 million more than in 1990. This level will support 1,145 RPGs, four fewer than in 1990. The number of noncompeting grants is proposed to increase from 745 to 867 in 1991, while the number of new and competing renewal awards is reduced by 126 for a total of 278 in 1991. Included in NIMH's 1991 proposed budget is a new molecular neurobiology research center bringing the total of research centers to 45. The intramural program is proposed to increase by $5 million over 1990 levels to $82 million.

Included in NIMH's 1991 request is $74 million for AIDS/HIV, representing an increase of $9 million over 1990 R&D levels. These funds will enable NIMH to continue research on the psychological, behavioral, and immunological variables and how their interrelationships affect an individual's immunity and health status.

National Institute for Drug Abuse (NIDA): This institute's main priority in 1991 is to establish stable support for research and development on drug abuse, ranging from basic studies of how drugs affect the central nervous system to large scale clinical trials for new treatment medications. The 1991 request includes $172 million for 796 RPGs, which includes 551 continuing grants and 245 new and competing renewal awards. A total of $17 million is proposed to support 24 research centers, including a new center to conduct prevention research among high risk groups. The intramural program is proposed to receive $24 million, an increase of $3 million over 1990 levels.

The 1991 request proposes $75 million for research and development on AIDS/HIV, $19 million more than in 1990. Intravenous drug abuse is the second largest risk factor for HIV infection in adults and the leading risk factor for children and heterosexual adults. Thus, one of NIDA's highest priorities is to develop more effective pharmacologic agents to treat drug addiction and behavioral interventions to prevent or stop drug abuse.

National Institute on Alcohol Abuse and Alcoholism (NIAAA): The NIAAA supports a comprehensive research program to develop the knowledge for improving prevention and treatment of alcoholism and alcohol-related problems. The 1991 request proposes $150 million for NIAAA, an increase of $7 million over the 1990 levels. Included in the request is $86 million for investigator-initiated research to support a total of 462 RPGs, 381 of which are noncompeting. Funding for research centers and intramural research are scheduled to remain at about 1990 levels.

R&D budget authority for the Alcohol, Drug Abuse, and Mental Health Administration 1/
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$729	$897	$991	10.5%
National Institute of Mental Health	371	430	456	6.0
Extramural research	260	313	332	6.0
Intramural research	72	77	82	6.0
Research management support	39	40	43	6.2
National Institute on Drug Abuse	188	248	292	17.9
Extramural research	154	199	235	17.8
Intramural research	15	21	24	12.6
Research management support	19	27	33	22.9
National Institute on Alcohol Abuse and Alcoholism	117	143	150	4.8
Extramural research	92	113	118	4.2
Intramural research	15	19	20	5.4
Research management support	10	11	12	9.9
All other	52	77	93	21.6

1/ Funding includes AIDS/HIV.

SOURCE: National Science Foundation, SRS

The request includes $9 million for research and development on AIDS/HIV, an increase of $1 million over 1990. The NIMH's research and development on AIDS/HIV focuses on the dynamics of alcohol-related behaviors that may increase the risk of contracting AIDS/HIV and epidemiological and prevention studies designed to elucidate the role of alcohol use in facilitating behaviors which increase the risk of HIV exposure.

Other Health Research

Centers for Disease Control (CDC): The CDC sponsors primarily applied research through both intramural and extramural programs. Its programs focus on the prevention of sexually transmitted, infectious, and chronic and environmental diseases, and occupational safety and health.

Research and development on AIDS/HIV at CDC is directed at identifying cellular and viral factors involved in HIV replication, developing new therapeutic interventions, developing and evaluating serologic tests for HIV antibodies, and investigating and characterizing variations of HIV isolates.

Agency for Health Care Policy and Research (AHCPR): In 1991, activities formerly undertaken by the National Center for Health Services Research and Health Care Technology Assessment under OASH have been requested in a separate appropriation. This new agency will support extramural and intramural research and development to address a broad range of health care services topics, such as patient outcomes, clinical effectiveness of particular medical treatments, health care to rural populations, and the level and quality of health care access.

Office of the Assistant Secretary for Health (OASH): OASH conducts and supports research on the organization, financing, and delivery of health services and the understanding of the issues surrounding adolescent pregnancy.

The 1991 request for OASH includes no funding for research and development on AIDS/HIV. The National AIDS Program Office, for which OASH requested R&D funding in previous years, was transferred to the Agency for Health Care Policy Research. Funding for these activities was not identified as research and development in the 1991 request.

Health Care Financing Administration (HCFA): HCFA supports research on quality of care, physician and ambulatory care payment systems, capitated payment systems, hospital payment, program efficiencies, health care prevention and access, and subacute and long-term care.

Health Resources and Services Administration (HRSA): HRSA R&D programs seek to improve the quality, effectiveness, and efficiency of services for mothers, children, and disabled children through the identification of methods for improving and delivering services. HRSA also supports the Hanson's Disease program which conducts basic and clinical research into the cause, epidemiology, diagnosis, early detection, prevention, control, and treatment of Hanson's Disease and complications resulting from this condition.

Indian Health Services (IHS): The research and development program of the IHS sponsors a broad array of research programs on nutrition and diseases that afflict the populations of American Indians and Alaskan Natives.

Consumer and Occupational Health and Safety programs

Food and Drug Administration (FDA): The FDA performs research that provides the basis upon which crucial regulatory decisions are made. Specific areas of research include foods, drugs, devices and radiological products, and toxicology.

Occupational Safety and Health Administration (OSHA): OSHA conducts and supports research to establish priorities and agendas for the completion and revision of standards, and to develop effective enforcement programs. OSHA conducts evaluations of the environmental impact of all proposed standards, in addition to regulatory analyses of new OSHA standards.

Summary of Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome R&D Programs

Federally-supported research and development on AIDS/HIV strives to enhance our understanding of how HIV affects the body, to produce effective means to disrupt its progress, and to develop vaccines to prevent infection. The PHS agencies that sponsor or conduct research and development on AIDS/HIV include the NIH, ADAMHA, CDC, and FDA. Other agencies which undertake research and development on AIDS/HIV, but whose activities fall under other functional categories, will be discussed in the appropriate chapter. The following discussion summarizes R&D funding for AIDS/HIV in the PHS agencies' proposed budgets.

Together, the combined budgets of the four PHS agencies conducting or sponsoring AIDS/HIV research and development is $1.0 billion, $84 million more than in 1990. Of this total, 75 percent is allocated to the NIH. The 1991 request provides increases in R&D funding for all four PHS agencies with the majority of the increase distributed between NIH and ADAMHA.

National Institutes of Health (NIH): The AIDS/HIV program at NIH encompasses basic and clinical research on the prevention and treatment of HIV infection. In 1991, a total of $775 million is proposed, an increase of $56 million or 8 percent over 1990. Basic science research programs will receive the majority of this growth ($43 million) with the balance going to risk assessment and prevention programs.

Although the 1991 request includes R&D funding for 16 NIH components, 75 percent of the NIH AIDS/HIV budget is proposed for NIAID and NCI. The NIAID is NIH's lead institute for sponsoring, conducting, and coordinating research on AIDS and HIV infection. The Division of Research Resources (DRR) and the NHLBI each receive about 6 percent of NIH's R&D funds for AIDS/HIV. The DRR supports AIDS/HIV clinical research in a national network of general clinical research centers.

The 1991 request includes $316 million for investigator-initiated research on AIDS/HIV, an increase of $26 million over 1990. This level will

R&D budget authority for the Human Immunodeficiency Virus and the Acquired Immunodeficiency Syndrome 1/

[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total................................	$735	$930	$1,014	9.0%
National Institutes of Health...........	585	719	775	7.7
National Institute of Allergy and Infectious Diseases.................	310	391	422	7.8
National Cancer Institute.............	122	150	161	7.0
Division of Research Resources........	39	45	48	8.5
National Heart, Lung, and Blood Institute..........................	38	42	44	5.7
National Institute of Child Health and Development........................	22	27	29	8.6
National Institute of Neurological Disorders and Stroke................	13	16	17	6.2
Office of the Director.................	12	11	13	14.5
All other............................	29	37	40	9.5
Alcohol, Drug Abuse, and Mental Health Administration.................	86	140	174	24.5
National Institute on Drug Abuse......	28	56	75	34.3
National Institute of Mental Health...	46	65	74	14.3
National Institute on Alcohol Abuse and Alcoholism.....................	6	8	9	11.4
All other............................	6	11	16	43.2
Centers for Disease Control.............	43	46	47	2.2
Federal Drug Administration.............	15	17	19	8.8
Assistant Secretary for Health..........	7	9	-	*

1/ Funding for Public Health Service agencies.

* No funding proposed in 1991.

SOURCE: National Science Foundation, SRS

support a total of 852 RPGs comprised of 239 new and competing renewal awards and 613 noncompeting grants. In 1991, the number of noncompeting grants will grow by 118, while the number of competing grants will remain the same as in 1990. Intramural funding for AIDS/HIV is proposed to receive $135 million, an increase of $26 million. The 1991 request also includes $61 million to support 23 research centers.

Alcohol, Drug, and Mental Health Administration (ADAMHA): Research and development on AIDS/HIV sponsored by ADAMHA seeks to advance the understanding of, assess, and treat neuropsychiatric, behavioral, and psychosocial aspects of HIV infection and AIDS. All three institutes are involved in AIDS/HIV activities, with the National Institute on Drug Abuse and the National Institute of Mental Health each receiving about 43 percent of ADAMHA's total funding. Because intravenous drug abuse is one of the highest risk factors for HIV infection, one of ADAMHA's highest priorities is to develop more effective agents to treat drug addiction and behavioral interventions to prevent or stop drug abuse.

Centers for Disease Control (CDC): The CDC's R&D activities on AIDS/HIV include epidemiological and laboratory studies to determine the natural history of HIV infection and to identify and monitor risk factors for HIV transmission.

Federal Drug Administration (FDA): The FDA funds research and development on AIDS/HIV to support studies on therapeutics, vaccines, and blood and blood products. The FDA supports research and review capabilities in virology, epidemiology, biochemistry, and biophysics.

SPACE RESEARCH AND TECHNOLOGY

Research and development within the space research and technology function (which includes subfunctions 253, 254, and 255 of function 250) is sponsored and conducted by the National Aeronautics and Space Administration (NASA). NASA's R&D programs reflect the priorities set by the National Space Policy, which is committed to establishing a permanently-manned Space Station, accelerating the pace of scientific investigations in space, and developing space technologies to meet the long-range goal of expanding human presence in space beyond near-Earth orbit.

Research and development activities within the space research and technology function are proposed to receive $7.6 billion in 1991, representing an increase of almost $2 billion over 1990. The majority of the growth is distributed among Space Station Freedom and two new initiatives, the Human Exploration Initiative, and the "Mission to Planet Earth." In 1991, research and development accounts for about 50 percent of NASA's total request. For space research and technolgy, data for research and development are available at the major program level only; subprogram activity data include R&D plant.

Major program changes in the 1991 request are highlighted below.

- In 1991, a total $2.5 billion, which includes $2.3 billion for research and development and $128 million for R&D plant, is proposed for Space Station Freedom. This represents an overall increase of $701 million, the largest dollar growth of any NASA R&D program.

- The capability development program within space transportation systems is proposed to receive $731 million for research and development and $42 million for R&D plant, for a total of $773 million in 1991. This represents an increase of $211 million over 1990.

- The space science program is proposed to receive $1.9 billion for research and development and R&D plant in 1991 with the majority of the $293 million increase distributed among the development of the Advanced X-Ray Astrophysic Facility (AXAF), the Comet Rendezvous Asteroid Flyby and Cassini missions, and the Shuttle and Space Station payload and instrument development program.

- In 1991, NASA is requesting $235 million for research and development and R&D plant for the Earth Observing System, within the space and terrestrial applications program, as a major component of NASA's "Mission to Planet Earth." The combined program elements of this NASA initiative are proposed to receive $636 million in 1991.

- As part of the Human Exploration Initiative, the 1991 request proposes $37 million in R&D funding to begin the Exploration Mission Studies Program. This program will study alternative strategies for expanding human presence beyond near-Earth orbit and eventually to Mars.

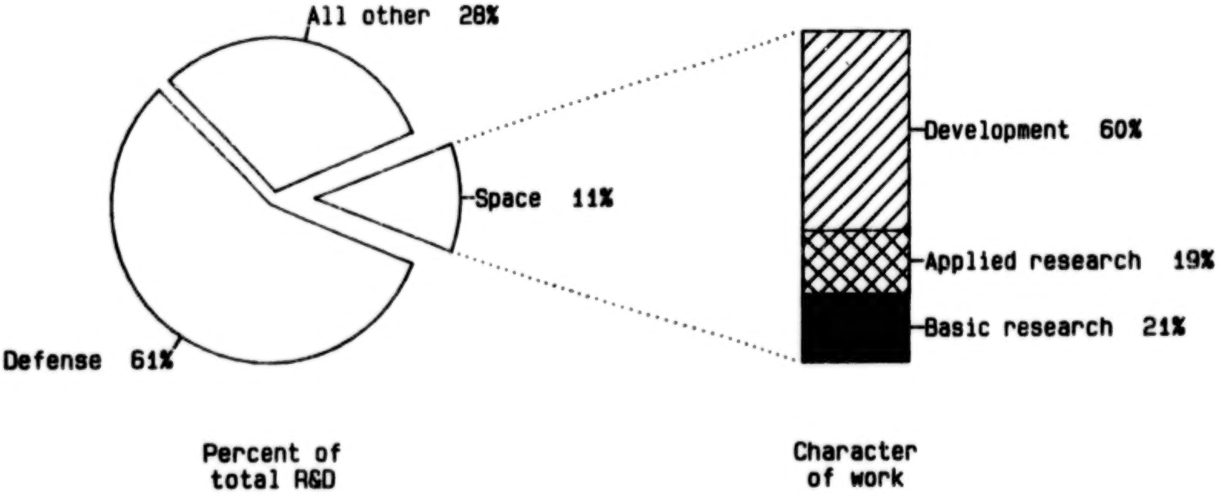
R&D budget authority for space research and technology
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$4,555	$5,577	$7,555	35.5%
National Aeronautics and Space Administration				
Space transportation systems	1,724	2,505	3,596	43.5
Space science	1,503	1,635	1,917	17.3
Space and terrestrial applications	748	805	1,041	29.4
Space research and technology	423	429	659	53.5
Commercial programs and technology utilization	59	72	116	62.0
Transatmospheric research and technology	43	38	68	79.0
University Programs	-	37	50	35.4
Safety reliability and quality assurance	34	35	49	38.3
Exploration mission studies	-	-	37	**
Space tracking and data advanced systems	21	22	23	3.9

** Proposed new initiative

SOURCE: National Science Foundation, SRS

R&D budget authority for space: 1991



SOURCE: National Science Foundation, SRS

Space Transportation Systems

Space transportation systems (STS) is comprised of the Space Station Freedom and the capability development programs. The 1991 request includes $3.6 billion for space transportation systems, an increase of $1.1 billion over 1990. The 1991 funding level comprises nearly one-half of the NASA's total proposed funding for research and development.

Space Station Freedom program (SSF): Space Station Freedom, the cornerstone of the civilian space program, will serve as a multipurpose, international research facility that will provide the United States with a permanently-manned presence in space. Space Station Freedom is designed to serve as a microgravity and life sciences laboratory, a platform for astronomical and Earth observations, and as a way station for manned missions beyond Earth orbits.

Space Station Freedom is proposed to receive $2.3 billion in 1991, an increase of $639 million over the 1990 level, the largest dollar increase of any NASA R&D program. The 1991 request enables the continued development of the U.S. portion of the baseline configuration consistent with NASA's revised schedule which retains the March 1995 launch of the first element. In addition, the 1991 funding level provides for slowed development of the Flight Telerobotic Servicer until NASA completes a review of the program.

Capability development program: This program supports an array of research and development activities aimed at enhancing the ability of the Shuttle to support its missions. It also includes the launch of unmanned payloads to deep space using Shuttle-based upper stage boosters, the development of the Orbital Maneuvering Vehicle, and the acquisition of launch services using expendable launch vehicles (ELVs). The eight program elements comprising the 1991 request are summarized below.

1. Engineering and technology base. This program element provides support for research and testing, data systems, and launch and flight operations at all manned space flight centers. The proposed increase will support increased contractor costs and general engineering lab support.

2. Spacelab. Spacelab is a reusable laboratory and observatory installed in the cargo bay of the orbiter that enables scientists to conduct experiments in the space environment. The proposed level of funding reflects the increased frequency in Spacelab launches and use.

3. Payload operations and support equipment. This program element, which combines the former payload operations and payload support equipment elements, provides general engineering, integration, and development of equipment to support the Space Station and Shuttle payloads. The 1991 request provides funding to furnish ongoing payload services for currently scheduled launches, to initiate technical integration of Shuttle and Space Station transportation requirements, and to develop a new Space Station docking system.

4. Upper stages. The upper stages element consists of several NASA and commercially-developed small boosters that assist in the deployment of

R&D budget authority for space transportation systems

[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total R&D 1/	$1,724	$2,505	$3,596	43.5%
Space Station R&D Plant	200	108	128	18.5
Capability development R&D Plant	45	172	42	-75.6
Total R&D and R&D Plant	1,970	2,785	3,765	35.2
Space Station program	900	1,750	2,451	40.1
Development	842	1,661	2,300	38.4
Flight telerobotic servicer	46	79	106	33.9
Advanced programs	12	9	36	300.0
Operations	-	-	9	**
Capability development program	674	562	773	37.5
Engineering and technical base	161	182	219	20.3
Spacelab	88	96	131	36.7
Payload operations & support equipment	61	67	123	83.7
Upper stages	132	85	91	7.9
Orbital Maneuvering Vehicle (OMV)	73	76	85	12.0
Advanced transportation technology	81	-	54	***
Advanced programs	53	34	53	58.3
Tethered Satellite System (TSS)	26	24	18	-25.4
Research and program management	396	473	541	14.4

1/ Funding for research and development is available at the major program level only; subprogram activities include funding for R&D plant.

** Proposed new initiative.

*** Funded by the Department of Defense in FY 1990.

SOURCE: National Science Foundation, SRS

Shuttle or ELV payloads. It also includes the Solid Propulsion Integrity Program (SPIP), which establishes the engineering capability for improving solid rocket motors. The 1991 request supports ongoing development of upper stages for the Tracking and Data Relay Satellite System, the Ulysses and Mars Observer missions, and the Advanced Communications Technology Satellite (ACTS). It also supports the continuation of the SPIP and initiation of procurement for the Centaur upper stages for the Comet Rendezvous Asteroid Flyby (CRAF) mission.

5. Orbital Maneuvering Vehicle (OMV). The OMV will provide a space tug capability for payload delivery, retrieval, and viewing of space objects beyond the reach of the Shuttle. The proposed increase will support design completion of the revised baseline vehicle and engineering support for conducting the critical design review in preparation for its scheduled 1994 flight.

6. Advanced transportation technology. This program element defines and develops technologies that will accommodate potential launch requirements of the Human Exploration Initiative, and the development of the advanced liquid cryogenic propulsion system to support advanced space transportation concepts. Funding is proposed to reinstate the civilian component of the Advanced Launch Systems (ALS), a joint NASA/DOD program to define heavy lift concepts to reduce Earth to orbit transportation costs. The 1991 request will also support the continuation of other ongoing ALS activities.

7. Advanced programs. Advanced programs supports studies of advanced transportation and future capabilities such as satellite servicing, advanced operations, and future manned systems. The 1991 request provides for definition studies on the evolution of manned vehicles and upper stage vehicle interfaces, the assessment of Centaur upgrades, and the initiation of definition of the Assured Crew Return Vehicle.

8. Tethered Satellite System (TSS). The TSS is a reusable space facility that will be used to observe atmospheric processes occurring within the lower atmosphere and crustal geomagnetic phenomena, and to conduct electrodynamic experiments interacting with space plasma. The proposed 1991 funding supports completion of flight planning and integration of the Italian satellite and scientific instruments in preparation for the verification flight in 1991.

Space science

Three space-related research programs comprise Space Science: Physics and astronomy, planetary exploration, and life sciences. Space science programs use a variety of space systems supported by ground-based and airborne observations to conduct a broad spectrum of scientific investigations of the Earth, its space environment, the Sun, the planets, the stars, and the universe.

Physics and astronomy: This program consists of a combination of large free-flying and Explorer spacecraft, Shuttle/Spacelab flights, and suborbital missions to investigate the environment of the planets, interplanetary medium, and distant space.

R&D budget authority for space science
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total R&D 1/	$1,503	$1,635	$1,917	17.3%
R&D Plant	6	11	22	96.0
Total R&D and R&D Plant	1,508	1,646	1,939	17.8
Physics and astronomy	737	861	985	14.4
Mission operations and data analysis	142	202	294	45.2
Research and analysis	85	110	123	11.9
Advanced x-ray astrophysics facility development (AXAF)	16	44	113	156.8
Explorer development	82	92	101	9.8
Global geospace science	64	67	99	46.6
Payload and instrument development	71	91	97	7.2
Payload mission management & integr	68	81	89	9.7
Suborbital program	45	53	55	4.4
Space station integrated planning and attached payloads	8	5	15	201.5
Hubble Space Telescope	105	82	-	*
Gamma Ray Observatory	51	35	-	*
Planetary exploration	417	392	485	23.9
Mission operations and data analysis	111	157	174	10.6
Comet Rendezvous Asteroid Flyby/ Cassini	-	30	148	401.4
Research and analysis	77	71	90	26.8
Mars observer (MGCO)	102	99	69	-30.3
Ulysses (ISPM)	10	14	3	-76.8
Mars baloon relay	-	4	2	-54.5
Galileo	73	17	-	*
Magellan (Venus Radar Mapper)	43	-	-	*
Life sciences	79	106	163	53.4
Human space flight and systems eng	29	41	71	74.5
Research and analysis	38	40	48	18.6
Space biological sciences	10	21	32	50.9
Search for extraterrestrial intell	2	4	12	202.5
Research and program management	273	287	306	6.5

1/ Funding for research and development is available at the major program level only; subprogram activities include funding for R&D plant.

* Termination of funding results from scheduled launches.

SOURCE: National Science Foundation, SRS

The 1991 request proposes $985 million for physics and astronomy, an increase of $124 million over 1990. The request is composed of planned increases and decreases for ongoing programs, funding to augment planning and development for several Space Station experiments and to initiate the development of the next-generation airborne infrared telescope (SOPHIA). The 11 program elements of this program are summarized below.

1. Mission operations and data analysis. This program element supports the operation of and the analysis of data received from in-flight physics and astronomy spacecraft. The proposed 1991 funding supports ongoing missions.

2. Research and analysis. This program element includes preliminary studies required to define missions and payload requirements for potential future missions. The 1991 request provides funds to support the continuation of ongoing studies.

3. Advance x-ray astrophysics facility (AXAF). Begun in 1989 as the third of four "Great Observatories," AXAF will provide new insights into stellar structure and evolution, large-scale galactic phenomena, active galaxies, clusters of galaxies, and cosmology. Funding request in 1991 will support AXAF mirror development and spacecraft definition studies.

4. Explorer development. The explorer development program element consists of a number of missions that are exploratory or do not require a major observatory. The 1991 request supports continued design and development of the Extreme Ultraviolet Explorer (EUVE), Solar-A, and the X-ray Timing Explorer as well as other small class explorers.

5. Global Geospace Science (GGS). The GGS is the U.S.'s contribution to a collaborative, international, multi-spacecraft effort designed to advance the understanding of the interaction between the Earth and the sun. The proposed 1991 funding provides for continued development of the GGS spacecraft, instruments, and ground system.

6. Payload and instrument development. This program element includes test, checkout, and design of instruments for long-duration free-flying missions. The 1991 request provides funding to continue development of U.S. instruments for the Japanese Geotail mission, the European Space Agency/NASA joint Cluster mission, the Solar and Heliospheric Observatory (SOHO), and the Tethered Satellite System. The proposed funding will also support Shuttle test flight of the Gravity Probe-B instrument and data analysis from the Astro-1 mission.

7. Shuttle/Spacelab payload mission management and integration. This program element manages the mission planning, integration, and execution of all NASA Spacelab and attached Shuttle payloads. The 1991 request provides increased funding to support the increased frequency of Spacelab missions.

8. Suborbital program. The suborbital program uses sounding rockets, balloons, and aircraft to conduct research on the Earth's ionosphere and magnetosphere, space plasma physics, stellar astronomy, solar astronomy, and high energy astrophysics. The proposed 1991 funding supports the continuation of suborbital research program and management and operation of National Scientific Balloon Facility.

9. Space Station integrated planning and attached payloads. This program element supports planning and attached payload definition for the Office of Space Science and Applications' use of Space Station Freedom. The 1991 request supports ongoing definition and development of the payloads selected for early flight on the Space Station.

10. Hubble Space Telescope (HST). The HST will provide unprecedented resolution and precision in space observations that will yield new information about the distant past of the universe. No funding is requested in 1991 for the HST due to its scheduled 1990 launch.

11. Gamma Ray Observatory. The Gamma Ray Observatory will study the highest energy electromagnetic radiation emitted from sources in the cosmos. No funding is requested in 1991 due to the observatory's scheduled 1990 launch.

Planetary exploration: This program encompasses scientific exploration of the solar system including the planets, their satellites, comets and asteroids, and the interplanetary medium. The 1991 request provides for the preparation of the Ulysses, scheduled for flight in 1990, and the Mars Observer, scheduled for launch in 1992. The request augments funding for the Comet Rendezvous Asteroid Flyby and the Cassini (the Saturn/Titan Probe) missions planned for launch in 1995. Funding was begun in 1990 for the Mars Balloon relay to conduct studies in anticipation of the Lunar Observer Mission, which will begin in 1992 as part of the Human Exploration Initiative.

Life sciences: This program has two chief objectives: To develop medical and biological systems which enable human habitation in space; and to advance knowledge about the life processes of the universe. The growth proposed in the 1991 request supports final preparations for the flight of the first international microgravity laboratory mission in 1991 and continued development of an integrated centrifuge facility for the SSF that will support a broad spectrum of life sciences research using small animals and plants. Increases for the research and analysis program element will support ongoing data analysis.

Space and Terrestrial Applications

The space and terrestrial applications program is concerned with observations of the Earth and its environment. The 1991 request includes \$1.0 billion for this program, providing an increase of \$235 million over 1990 levels. The majority of the proposed growth goes to the earth sciences and applications program to support the Earth Observing System (EOS), a new initiative, and the polar platform program, which was formerly supported under the Space Station Freedom program. Of the remaining three program elements, only communications is proposed to receive funding at a level above the current 1990 estimate.

Earth science and applications: This program seeks to understand the Earth as an integrated system. It consists of a series of satellite missions with supporting ground-based measurements, laboratory studies, and data analysis. The satellite missions all serve as precursors to the "Mission to Planet Earth," NASA's contribution to the U.S. Global Change Research program. The

R&D budget authority for space and terrestrial applications

[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total R&D 1/	$748	$805	$1,041	29.3%
R&D Plant	9	11	8	-27.9
Total R&D and R&D Plant	757	816	1,049	28.5
Earth science and applications program	403	439	662	50.6
Earth Observing System	-	-	235	**
Process studies	94	106	111	4.6
Ocean Topography Experiment (TOPEX)	83	81	68	-15.8
Upper Atmosphere Research Satellite	85	64	66	2.8
Payload and instrument development	46	76	50	-34.7
Modeling and data analysis	34	39	41	7.3
Mission operations and data analysis	18	24	30	27.2
Earth probes	-	-	25	**
Airborne science and applications	23	19	20	4.1
Laser research facilities	8	8	9	8.7
Scatterometer (NSCAT)	11	14	4	-72.8
Interdisciplinary research & analysis	2	9	2	-72.1
Materials processing in space	76	99	97	-1.7
Materials experiment operations	56	81	80	-1.9
Research and analysis	14	13	14	9.0
Commercial microgravity R&D enhancements	6	5	4	-26.0
Communications	92	78	53	-32.3
Adv. comm. technology satellite (ACTS)	75	60	34	-43.3
Advanced communications research	12	12	13	1.8
Radio science and support studies	3	3	3	10.1
Communications data analysis	1	1	2	10.4
Search & rescue	1	1	1	9.4
Information systems	20	28	37	30.4
Research and program management	166	171	200	16.9

1/ Funding for research and development is available at the major program level only; subprogram activities include funding for R&D plant.

** Proposed new initiative.

SOURCE: National Science Foundation, SRS

12 program elements that comprise this program are summarized below.

1. Earth Observing System (EOS). The EOS is a major new program and the first component of NASA's Mission to Planet Earth. The EOS will consist of a series of instruments attached to polar platforms of Space Station Freedom and Japanese and European platforms that will provide, for the first time, simultaneous observations of a multitude of the Earth's physical features. The 1991 request includes funding to initiate the development of the Earth Observing System and to continue the development of the polar platforms, which were previously supported under the Space Station Freedom program.

2. Process studies. Process studies is the largest of three elements of the supporting research and analysis program, which was reorganized in the 1991 request to reflect the government-wide interdisciplinary approach to the study of the Earth as a system. The process studies program is concerned with radiation dynamics and hydrology, exosystem dynamics and biogeochemical cycles, atmospheric chemistry, and solid Earth science.

3. Ocean topography experiment (TOPEX). This mission will enhance the understanding of surface ocean circulation using satellite radar altimetry. The 1991 request supports full-scale spacecraft system integration in preparation for its 1992 launch aboard Ariannespace.

4. Upper atmosphere research satellite (UARS). The UARS mission, scheduled for launch in 1991, consists of 10 instruments which will provide the first integrated measurements of ozone concentration, chemical species affecting the ozone, energy inputs, temperature, and winds of the upper atmosphere. The 1991 request provides funding to continue both integration and calibration of the UARS instruments.

5. Payload and instrument development. The Space Station and Shuttle payload and instrument development program develops and tests Earth-viewing remote sensing instruments and systems for basic research projects and conducts feasibility studies for major free-flying spacecraft. The proposed increase in 1991 supports several projects including the Measurement of Air Pollution from Satellites (MAPS) experiment, the Active Cavity Radiometer-1, and the Atmosphere Trace Molecules Observed by Spectroscopy (ATMOS).

6. Modeling and data analysis. This program element is a second component of the restructured interdisciplinary research and analysis program. It focuses on developing predictive models for global change and analyzing data sets to determine mechanisms at work in the global environment. In 1991, particular emphasis will be placed on readying stratopheric photochemical models for analysis of data to be obtained from the UARS mission.

7. Mission operations and data analysis. This program element supports program operation, data processing, validation, and analysis of missions currently in flight. The 1991 request provides funds for continued operation of the Nimbus satellite launched in 1978 and for processing the data it continues to provide.

8. Earth probes. Earth probes are a second component of NASA's Mission to Planet Earth which will consist of explorer-class probes to address specific, highly focused problems in Earth science. There are two currently

planned Earth probes, the Total Ozone Mapping Spectrometer (TOMS) and NASA's Scatterometer. Other probes will include the Tropical Rainfall Mapping Mission and the Proteus ocean productivity experiment. The proposed 1991 funding will support continued development of the Scatterometer and the initiation of development of the TOMS free-flyer spacecraft.

9. Airborne science and applications. This program element includes operation and maintenance of aircraft that support Earth-sensing and atmospheric research. The 1991 funding level maintains support for these aircraft.

10. Laser research facilities. The third element of the restructured research and analysis program, laser research facilities uses lasers to measure the movement and deformation of the tectonic plates of the Earth. Funding in 1991 supports ongoing measurements of plate motion between North America and Europe, the Pacific Plate, and regional crustal deformation in western North America.

11. Scatterometer. The Scatterometer, scheduled for launch in 1995 on the Japanese ADEOS mission, will provide accurate measurements of ocean surface winds useful for both oceanography and meteorology. The 1991 request supports the continuation of flight hardware development.

12. Interdisciplinary data and analysis. Activities within this program provide quantitative characterizations of the chemical, physical, and biological processes of the Earth's surface. Funding in 1991 will support ongoing studies.

Materials processing in space: The goal of this program is to understand gravity-dependent physical phenomena. This program is comprised of materials experiment operations, research and analysis, and commercial microgravity R&D enhancements. Proposed funding for the materials experiment operations program will support Space Station hardware definition and equipment development and delivery for the first U.S. Microgravity Laboratory. Research and analysis provides the scientific foundation for all current and future projects. The commercial microgravity R&D enhancements budget supports several projects formerly managed by NASA's Office of Commercial Programs. These programs support the modification of existing microgravity research hardware to accommodate members of the commercial user community.

Communications: This NASA program includes activities involved with the development of advanced communication satellite technology. Reinstated by Congress in 1990, the ACTS program is designed to advance the current capabilities of communication satellites. The 1991 request for ACTS will support integration and testing of the ACTS flight and grounds systems in preparation for its scheduled 1992 flight. In addition, the proposed funding provides for the continuation of other ongoing activities of the remaining program elements.

Information Systems: This program provides advanced computer and information systems technology for the Office of Space Science and Applications. The 1991 request provides for the continuation of program activities and for previously deferred data systems improvements.

R&D budget authority for the space research and technology program

[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total R&D 1/	$423	$429	$659	53.5%
R&D Plant	12	14	7	-51.5
Total R&D and R&D Plant	435	443	666	50.2
Exploration technology program	40	27	179	566.9
Surface operations	16	14	62	355.9
Space transportation	7	3	38	1,051.5
Humans support	6	3	25	916.0
In-space operations	4	2	23	1,050.0
Information systems and automation	-	-	11	**
Nuclear propulsion	-	-	11	**
Lunar and Mars science	1	1	5	800.0
Innovative technologies and systems analyses	-	-	5	**
Mission studies	5	5	-	*
Civil space technology initiative	122	124	171	38.1
Vehicle	13	36	70	94.4
Propulsion	36	23	31	39.1
Automation and robotics	26	23	25	9.1
Large structures and control	20	17	20	19.2
Information technology	15	15	14	-8.7
Power	12	11	11	3.7
Research and technology base	124	125	126	0.6
University space research	16	17	18	3.5
Materials and structures	21	16	16	-1.2
Space flight	19	20	16	-23.9
Information sciences	7	7	15	104.1
Propulsion	14	14	14	-4.0
Space energy conversion	13	13	13	-0.8
Aerothermodynamics	10	12	11	-4.8
Space data and communications	8	9	9	0.0
Systems analysis	7	6	6	2.9
Controls and guidance	5	5	5	-13.5
Human factors	4	5	4	-15.2
In-space experiments technology program	-	10	20	94.1
Research and program management	149	157	170	8.0

1/ Funding for research and development is available at the major program level only; subprogram activities include funding for R&D plant.

* Proposed for elimination.

** Proposed new initiative.

SOURCE: National Science Foundation, SRS

Space Research and Technology

Space research and technology programs are aimed at advancing technologies for future space missions. All four elements within this program are proposed to receive increases in 1991, however, the majority of the growth goes to the exploration technology program (formerly the Pathfinder program).

Exploration technology program: This program's objective is to strengthen the underlying technologies that will enable future human and robotic solar system exploration missions. The 1991 request reflects additional funding to begin three new elements, information systems and automation, nuclear propulsion, and innovative technologies and systems analysis, and to augment existing program elements begun in 1989 under the former Pathfinder program.

Civil Space Technology Initiative (CSTI): This initiative was begun in 1988 to revitalize the Nation's civil space capabilities for future Earth orbit missions. CSTI programs develop technologies to facilitate access to and increase the effectiveness of science missions in Earth orbits. Growth in this program is due largely to the increase proposed for the vehicle component efforts on the Aeroassist Flight Experiment which will lead to the design of an aeroassisted Space Transfer Vehicle.

Research and technology base: This program supports exploratory research to improve performance, reliability, and cost effectiveness of a wide array of technologies supporting space exploration. Also supported is space research at universities to enhance the Nation's engineering community and bolster the number of available qualified space engineers. The 1991 request maintains the overall funding level for space research and technology at approximately 1990 levels.

In-space experiments technology (IN-STEP): The purpose of IN-STEP is to develop key flight experiments to provide validated, advanced space technologies that will enhance the effectiveness and efficiency of future space missions. IN-STEP will provide the space environment necessary to test and validate highly-innovative technology concepts identified in the research and technology base program. The proposed increase for this program will provide for the continued development of selected technology experiments for flight validation on the Space Shuttle and ELVs in 1991 through 1993 and to initiate hardware design and fabrication of several flight experiments.

Other space research and technology programs

Commercial Programs and Technology Utilization: The objective of commercial programs is to increase private sector awareness of space opportunities and encourage industrial investment in high technology and space-based research and development. The technology utilization program strives to accelerate the dissemination of the advances achieved through NASA research, technology, and development to both the public and private sectors.

Transatmospheric research and technology: Funding for this NASA program is included under both the space and transportation functions. This program is the joint NASA/Department of Defense National Aerospace Plane program, which will develop and demonstrate a reusable, single stage-to-orbit vehicle with air breathing primary propulsion and horizontal takeoff and landing.

Exploration mission studies: Exploration mission studies conducts analyses of science opportunities to determine alternative exploration pathways and strategies that would expand human presence beyond Earth orbit. Fiscal year 1991 is the first year for which direct funding is requested for this program. Prior year funding was contained within the space research and technology, space science and applications, and space transportation programs.

GENERAL SCIENCE

Research and development activities within general science (subfunction 251 of function 250) are funded by the National Science Foundation (NSF) and the Department of Energy (DOE). General science programs contribute to developing the Nation's fundamental research base in science and engineering.

The general science function is proposed to receive $2.8 billion for research in 1991, a 13-percent increase over 1990 funding levels. Of the general science research funds, over 95 percent are devoted to the conduct of basic research; less than 5 percent are allocated for applied research. No development is funded within the general science function.

The increase in funding for general science is attributable to the Administration's commitment to significant support for research and education in science and engineering, renewed research efforts in support of the Superconducting Super Collider, and the return to a path that would achieve a doubling of NSF's budget over the 1987 level in 1993. Major changes proposed for general science research funding are highlighted below.

o NSF is scheduled to receive $2.0 billion, a 12-percent increase in funding for research programs in 1991. All NSF directorates are proposed to receive increased funding.

o The geosciences directorate is proposed to experience the largest growth, 18 percent, or $59 million, to $380 million. This will provide for support of the global geosciences program, the focus of NSF's contribution to the U.S. Global Change Research Program.

o The biological and behavioral sciences directorate is proposed to receive an 11-percent, or $32 million, increase to $324 million. Funding will be directed toward support for the genome project to map and sequence a model plant system, global environmental change, and computational biology and databases.

o NSF funding for science and technology centers is proposed to increase 94 percent over 1990 to $43 million and 10-12 new centers, deferred from 1990, are proposed. Support for existing engineering research centers will increase 19 percent from 1990.

o The U.S. Antarctic program's major multi-year safety, environment, and health initiative which began in 1990 will be expanded significantly in 1991. Research funding for the Antarctic program is proposed to increase by 14 percent to $153 million.

o The budget calls for 13-percent growth in funding for DOE general science research programs, bringing the total to $830 million.

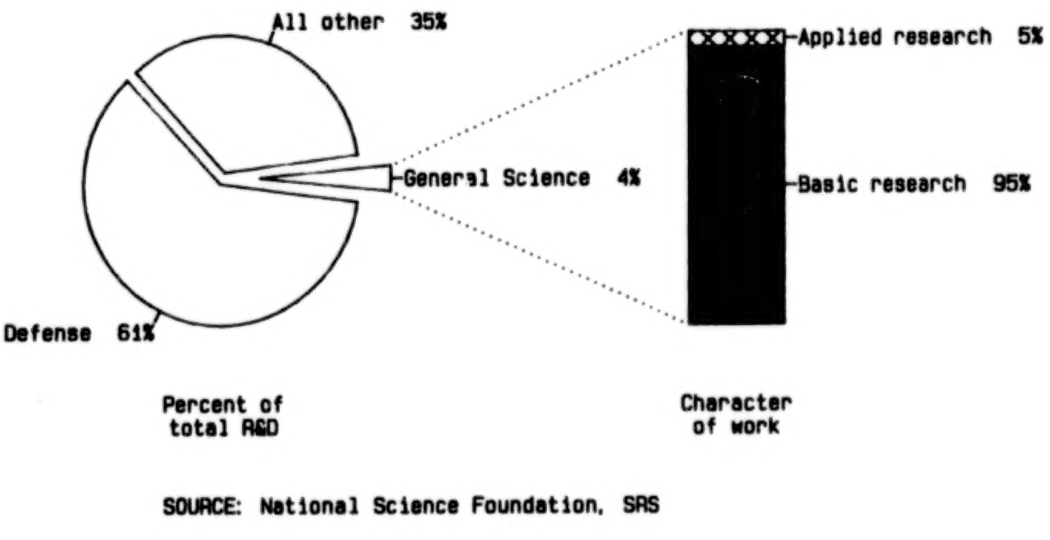
o Proposed research funding for the Superconducting Super Collider will increase 62 percent to $110 million with renewed emphasis on research related to accelerator systems and detectors, the conceptual design of components, and the industrialization of magnet fabrication.

R&D budget authority for general science
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$2,373	$2,499	$2,813	12.6%
National Science Foundation 1/	1,670	1,766	1,983	12.3
Mathematical and physical sciences	484	498	536	7.7
Geosciences	306	321	380	18.1
Biological, behavioral, and social sciences	280	292	324	10.9
Engineering	187	200	226	12.8
Computer information science and engineering	138	154	177	15.0
U.S. Antarctic program	118	135	153	13.5
Scientific, technological, and international affairs	54	58	68	17.0
Science and engineering education	15	16	16	4.5
Program development and management	87	92	103	12.3
Department of Energy	703	733	830	13.2
High energy physics	431	463	494	6.8
Nuclear physics	187	198	216	8.6
Superconducting Super Collider	82	68	110	62.2
Program direction	3	4	10	150.9

1/ Funds to support R&D activities at science and technology centers are included in the directorate with oversight.
SOURCE: National Science Foundation, SRS

R&D budget authority for general science: 1991



SOURCE: National Science Foundation, SRS

National Science Foundation

NSF plays a pivotal role in promoting innovation through its support of the research infrastructure across a wide range of science and engineering disciplines and educational efforts. The knowledge base and skilled people produced by this infrastructure determine the pace of technological change and the maintenance of competitive positions in international markets. The Foundation's 1991 proposed overall plan centers around two strategic themes: (1) strengthening the research base and improving academic facilities and equipment, and (2) developing human resources, broadening participation, and improving science and engineering education at all levels.

Research continues to be the primary focus of NSF support, accounting for over 83 percent of President's 1991 budget request for the Foundation. Funding for research programs in NSF is proposed to increase by 12 percent, to $2.0 billion, in 1991. Of these funds, 93 percent will be used to support basic research, primarily at universities and nonprofit organizations. Special emphasis will be placed on studies related to global change, an effort to map and sequence a plant genome, and funding for a second group of 10-12 science and technology research centers, deferred from 1990 due to budget constraints.

A portion of the requested increase in research funds within each directorate will be used to strengthen instrumentation, to expand opportunities for women and underrepresented minorities, and to increase access to research experiences for both graduate and undergraduate students. These research-related activities complement the programs of the science and engineering education directorate.

Mathematical and physical sciences

The mathematical and physical sciences directorate (MPS) supports research that leads to a better understanding of the physical laws governing the world in which we live. Research in the MPS disciplines, including mathematics, physics, materials research, chemistry, and astronomy, establish the knowledge and human resource base for future technological developments.

The 1991 request for research funding for the MPS directorate is $536 million, a nearly 8-percent increase over 1990. MPS is proposed to receive 27 percent of NSF research funding. The 1991 program continues emphasis on high temperature superconductivity research and research related to the very long baseline array radio telescope. Support will continue for the six science and technology centers established in 1989 and additional funds are included for new centers to be established in 1991.

Physics: The physics program supports the development of new knowledge about the existence, structure, and interactions of the various forms of matter and energy, and about the basic forces that govern these interactions. The 1991 budget request continues past emphases on maintaining and upgrading research facilities, undergraduate education, support for new investigators, and theoretical studies. Special research initiatives include cosmology, and complex systems and chaos. Of particular note is the proposed continuing support for the development of an ultra-high energy cosmic ray detector.

Materials research: Research on high temperature superconductivity remains a major focus of the program. Support for fundamental research in biomolecular materials and in the synthesis and processing of advanced materials will be increased. Materials research laboratories and formally recognized groups of investigators will continue to be important to the program with one additional group to be established in 1991 (for a total of 18 groups). Funding will continue for research activities at user facilities including centers for synchrotron radiation, small-angle neutron scattering, high magnetic fields, and high resolution electron microscopy.

Chemistry: In 1991, support will be increased for selected research projects with unusually high potential. Two interdisciplinary initiatives - materials chemistry and chemical processing, and chemistry of life processes -- will be enhanced. Included in the initiatives are research projects on superconductivity, advanced materials for information technologies, the chemistry of the senses, membrane chemistry, and man-made enzymes. Increased funding for collaborative research at the interface of chemistry with materials research, chemical engineering, and biological sciences will be provided.

Astronomical sciences: The astronomical sciences program supports research at universities and three national astronomy centers. Continued emphases in

R&D budget authority for mathematical and physical sciences
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$484	$498	$536	7.7%
Physical sciences	407	416	440	5.6
Physics	119	123	129	5.2
Materials research	114	116	122	5.6
Chemistry	97	98	103	5.5
Astronomical sciences	76	80	85	6.3
Mathematical sciences	66	69	74	6.7
Science and technology centers	12	12	23	86.0

SOURCE: National Science Foundation, SRS

the 1991 plan include research on cosmology and the structure of the universe, and development of array detectors, particularly in the infrared region of the spectrum. Increased support will be given for development of adaptive optics systems for moderate aperture telescopes and development of large, lightweight borosilicate glass mirror blanks. Partial operation of the very long baseline array system in support of research will commence.

Mathematical sciences: Special attention will be given to strengthening research support for interactions with other disciplines, computational mathematics, and incorporating geometric ideas and methods throughout the mathematical sciences. Continued support will be given to research in support of undergraduate curriculum development, particularly in calculus and enhancing research opportunities for new investigators and underrepresented minorities.

Geosciences

The geosciences directorate (GEO) supports research that contributes to an understanding of the global environment and natural and human activities influencing that environment. The geosciences include atmospheric, ocean, and earth sciences. Activities conducted in the polar regions are also part of GEO. The global geosciences program within the directorate is the focus of NSF's contribution to the U.S. Global Change Research Program. NSF's global geosciences program, in coordination with six other Federal agencies, provides support for the basic research necessary to understand and predict climatic and human influences on the environment.

The 1991 request for research funding for the GEO directorate is $380 million, an 18-percent increase over 1990. GEO is proposed to receive 19 percent of NSF research funding. Major increases are proposed for global geoscience program activities with emphasis on the research necessary to

R&D budget authority for geosciences
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$306	$321	$380	18.1%
Ocean sciences	146	147	171	16.0
Atmospheric sciences	95	100	116	15.4
Earth sciences	54	60	72	19.0
Arctic research	10	12	17	33.7
Science and technology centers	1	1	4	351.5

SOURCE: National Science Foundation, SRS

model the earth's component systems including atmospheric chemistry and biogeochemical studies, studies of climate change, the earth's hydrologic system, changes in earth history on geologic time scales, and studies of ocean circulation. A new initiative on arctic social sciences will begin in 1991, as will research in support of a U.S. global change education and training program. Support for science and technology centers within the directorate will increase by over 350 percent.

Ocean sciences: Research support increases will focus on global change through interdisciplinary ocean studies that form major components of the NSF global geosciences program. Noteworthy are the implementation of the world ocean circulation experiment, expansion of the joint global ocean flux study (JGOFS) with a Pacific equatorial biogeochemical flux field program, initiation of a ridge interdisciplinary global experiment (RIDGE) field program on the East-Pacific rise, participation in the tropical ocean global atmosphere coupled ocean atmosphere response experiment (TOGA-COARE), and long lead-time instrumentation and model development for the global ocean ecosystem dynamics program (GLOBEC). Support within the ocean drilling program will be focused on development of measurement and sampling tools for high temperature ridge-crest environments, measurement of crustal deformation and fluid flow in boreholes, definition of the high-latitude regional geologic framework, and increased support for analysis of geochemical and geophysical logging data.

Atmospheric sciences: Research activities related to the global geosciences program will include the ongoing global tropospheric chemistry program, the tropical ocean global atmosphere program, and the coupling, energetics and dynamics of atmospheric regions program. All of these activities will be focused on preparing and mounting major field programs including TOGA-COARE. Additional activities will include the following: (1) development of data processing techniques, (2) development and management of data bases, (3) research on abrupt climate change on decadal to millennial time scales, (4) arctic systems science, (5) studies to examine the interactions of global atmospheric energetics and water substance with climate, and (6) modeling studies of the geospace environment with emphasis on the magnetospheric cusp.

Earth sciences: Project support in the earth sciences involves the full spectrum of topics in the disciplines of geology, geochemistry, geophysics and paleobiology. In 1991, emphasis will be placed on components of the global geosciences program. This includes increases in funding for the geodynamics and geologic record of global change programs and a new program on continental hydrologic processes. The continental dynamics program will continue research support in the following areas: (1) continental scientific drilling (2) geological, geophysical, and geochemical studies of large-scale crustal features, and (3) the use of seismic reflection profiling and seismic array studies to image the earth's crust and upper mantle.

Arctic research: This program supports scientific research on the Arctic that encompasses all aspects of the region's resources and environment. Among the research projects to be supported are the northern components of bipolar investigations, particularly in glaciology and upper atmospheric physics. Approximately one-quarter of the increase in funding for arctic research will be used to initiate an arctic social sciences program. The balance of the increase will go toward the arctic system sciences program which focuses on environmental change in the Arctic. Paleoclimate studies from ice sheets are a key part of this effort; the Greenland ice-coring project will receive increased support. Additional funds will be used for coordinated interdisciplinary research on arctic ocean, sea ice, and atmospheric interactions, and to support smaller scale studies on arctic terrestrial ecosystems and biogeochemical cycles.

Biological, behavioral, and social sciences

Biological, behavioral, and social sciences directorate (BBS) research programs seek to meet several goals: (1) increase understanding of the ways chemical and physical events underlie fundamental life processes, (2) provide insights into the interactions of biological systems and their environments, (3) increase knowledge of the nervous system and the biological and cultural factors that influence the behavior of humans and other animals, and (4) explain how various social and economic systems are organized and operate. Many BBS research areas are multidisciplinary.

The 1991 request for research funding for BBS is $324 million, an 11-percent increase over 1990. BBS is proposed to receive 16 percent of NSF research funding. High priority areas in 1991 include initiation of support for mapping a model plant genome, expanded research in global environmental change, continuing support for computational biology and databases, development of computing and information software capability in the ecological sciences to support large-scale studies, and establishment of additional science and technology centers.

R&D budget authority for biological, behavioral, and social sciences
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$280	$292	$324	10.9%
Biotic systems and resources	63	67	73	10.0
Cellular biosciences	56	57	63	10.0
Molecular biosciences	47	48	52	8.2
Behavioral and neural sciences	45	46	49	7.0
Instrumentation and resources	37	38	43	12.4
Social and economic sciences	31	32	35	10.0
Science and technology centers	3	3	8	131.1

SOURCE: National Science Foundation, SRS

Biotic systems and resources: Emphasis will be placed on studies in the following areas: (1) ecological effects of global environmental change including biogenic emissions of greenhouse gases and their effects on other ecosystem properties, (2) responses of whole communities and their component species to climate change using ground-based and remote sensing, (3) inventories of the biota of key environments, and (4) expansion of the directorate-wide competition in conservation and restoration biology begun in 1990. Continued support is proposed for many other areas of research: molecular techniques for determining genetic relationships among organisms; microbial ecology; curation of natural history collections necessitated by increased studies of world-wide biological diversity; and completion of wide area networking and the development of cross-site databases for the long-term ecological research sites. As part of the computational biology and database initiative, additional funds will be used for integrative projects such as the modeling of ecosystem responses to climate change and producing geographic information systems that allow the study of changes in biotic composition and range through historical and geological time.

Cellular biosciences: Continued development of biotechnology and fundamental research on reproduction, development, growth, and physiological function will be the foci of cellular biosciences. Support will be strengthened for research in several areas: (1) elucidating the biochemical, cellular, and physiological processes that contribute to changes in the global environment, (2) advancing the understanding of reproduction, growth, and defense mechanisms applicable to preserving and managing biodiversity, (3) using biotechnological techniques to address fundamental questions about cellular, developmental, and physiological biology of plants, (4) studying the identification, isolation, characterization, and regulation of genes important in the development of organisms, and (5) investigating mechanisms by which cells of plants and animals receive signals, process the information biochemically, and respond by releasing other signal molecules or by changing their patterns of gene expression.

Molecular biosciences: This program area supports research that increases the fundamental understanding of the chemical, genetic, and physical processes underlying biological phenomena. The molecular biosciences are vital contributors to biotechnology and the understanding of fundamental mechanisms underlying photosynthesis and nitrogen fixation. Molecular biosciences will place additional support in plant molecular biology, especially mapping and genetic sequence projects for a model plant system, efforts to understand the molecular and genetic basis of biodiversity, and elaboration of the molecular structure of important biological molecules using nuclear magnetic resonance and x-ray diffraction techniques.

Behavioral and neural sciences: This program serves as the bridge between the biological and social sciences by advancing the understanding of the biological, environmental, and cultural factors that underlie the behavior of humans and animals. Programs include anthropology, neurosciences, the biological basis of behavior, and language, cognition, and social behavior. The most substantial growth in funding will support additional research on animal behavior related to biodiversity and research on the biological basis of behavior (including the neurobiology of learning and memory), and understanding hormonal influences on the central nervous system. Increased support will also be provided for experimental studies of the biological underpinnings of language and cognition, and the rapidly growing area of computational neuroscience, especially computer simulation and modeling of neurons and neural networks as they relate to behavioral functions.

Instrumentation and resources: Increased support for advanced instrumentation and sophisticated techniques, and opportunities for advanced training for their use in research will continue to be emphasized. The biological database initiative will be supported with funds to augment ongoing efforts to increase access to computers and develop specialized computer applications across the biological sciences. Support will continue for the development of techniques and instrumentation for specialized research efforts. One proposed effort is in optical microscopy which could be used for examining the implications of cellular structure and dynamics of the function of cells both in culture and in the nervous system.

Social and economic sciences: Major new emphasis will be placed on research and data development on the human dimensions of global environmental change through studies of the following: (1) human interactions with physical and biological processes including anthrogenic causes of global environmental change, (2) the effects of regulation, economic and commodity markets, and population growth and distribution on global change, and (3) methodological problems in creating comparable cross-national data bases on environmentally significant activities. Other activities that will continue to be emphasized are research to improve our knowledge of technological and non-technological factors in economic competitiveness, and multi-user research resources, including both large-scale data bases and special purpose data collection. In addition, support is continued for the National Center for Geographical Information and Analysis.

Engineering

The engineering directorate (ENG) seeks to promote the progress of engineering and technology in the U.S. including strengthening the engineering knowledge base, encouraging technological innovation, promoting cross-disciplinary and systems-oriented research, improving the quality of engineering education, and encouraging greater participation by women and underrepresented minorities. The directorate accomplishes its mission by supporting research and education at all levels and in all fields of engineering, developing the Nation's engineering resources, and stimulating changes in the culture of the engineering profession to meet the Nation's needs.

The 1991 request for research funding for the ENG directorate is $226 million, a 13-percent increase over 1990. ENG is proposed to receive 11 percent of NSF research funding. In 1991, additional support will be given to a number of important topics such as down-stream biochemical processing, optical high-speed communications, design and manufacturing, hazard mitigation, and research to prevent or alleviate damage to the environment. Special emphasis will be placed on research on the processing of advanced materials. Ongoing initiatives in strategic manufacturing, neuroengineering, optical communications, biotechnology, and environmental and ocean engineering systems also will receive increased support. Four new industry/university cooperative research centers are proposed.

In 1990 the engineering directorate established the engineering infrastructure development (EID) subactivity to provide a clearer management focus for support of engineering education, equipment and instrumentation, and programs to develop human resources. No research topic supported under the old structure has been eliminated; those related to EID's mission have been transferred from other subactivities.

Biological and critical systems: The bioengineering and environmental systems programs support research to improve the ability to cope with threats to the physical environment and to explore basic engineering problems related to ocean resources. The hazard mitigation programs support research to provide new engineering capabilities to understand, prepare for, and recover from natural disasters. The special research thrust in the downstream processing of bioproducts begun in 1990 will continue. Other activities of particular note are the following: (1) new research on tissue replacement materials, (2) research on "smart" biomaterials involving molecular self-assemble, adhesive proteins, and bioelectronics materials, (3) initiation of research on waste management practices that adversely impact coastal environmental quality, and (4) initiation of earthquake hazards mitigation research on seismic resistant active control systems for structures in earthquake-prone areas.

Chemical and thermal systems: The development of an engineering base for technologies involving chemical, thermal, and flow processes important in areas such as microelectronics, specialty chemicals, pharmaceuticals, energy production, advanced materials, and the processing of hazardous waste are all supported by chemical and thermal systems funds. In 1991, research support will be increased in the following areas: (1) combustion and

R&D budget authority for engineering
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total............................	$187	$200	$226	12.9%
Biological and critical systems.........	34	36	36	1.5
Chemical and thermal systems............	31	31	33	8.1
Electrical and communications systems...	30	30	32	7.1
Mechanical and structural systems.......	23	23	24	7.5
Design and manufacturing systems........	18	18	20	8.1
Engineering infrastructure development..	11	17	25	51.2
Engineering centers.....................	40	46	55	19.1

SOURCE: National Science Foundation, SRS

chemical processes related to processing materials of high purity, (2) new chemical reaction processes, (3) characterization and modeling of fluids with microscopic structure with applications to thin films, coatings, ceramic slurries, and sediment flow, (4) development of microporous synthetic materials for bio-separation membranes with high selectivity, (5) processing of advanced electronic and optical materials, (6) separations processes of environmental importance, and (7) microscale chemical processing.

Electrical and communications systems: Major support will be given to research in several areas: (1) low-temperature plasmas for plasma-assisted materials processing and related microelectronic processing technologies, (2) advanced optoelectronic devices and materials for high-speed optical communications, (3) critical problems at the interface of optical materials, devices and systems research that stand in the way of achieving the potential of all-optical networks, and (4) design techniques for the analysis and synthesis of complex feedback control systems with emphasis on electric power systems. Research in solid state sensors and microelectromechanical devices will continue to be funded; funding in these areas has been transferred from the communications and computational systems program to the solid state and microstructures program.

Mechanical and structural systems: Research will be directed toward the design and control of machine systems with superior performance characteristics, the creation of new and more cost effective structures, the understanding of mechanisms for deterioration of constructed structures, and fundamental research on geomechanics to improve ground stability and performance of surface and subsurface structures. Additional funding will be used to increase support for research in developing novel processing methods which involve both modeling and microstructural control, design of intelligent control systems, and quantitative nondestructive evaluation of materials and large structural systems. In addition, a test site for geotechnical engineering research will be established.

Design and manufacturing systems: This activity seeks to expand the scientific foundations of design, manufacturing, and computer-integrated engineering across a broad spectrum of American industry. The 1991 program will increase support for research on strategic manufacturing topics such as the following: (1) integrating manufacturing processes and systems, (2) integrating information on parts design, planning, scheduling, materials handling, and processing, (3) developing advanced processing methods for newly engineered and difficult-to-process materials, (4) developing next generation machine tools and manufacturing equipment to achieve superior performance and reliability, and (5) undertaking further refinement of rapid prototyping.

Engineering infrastructure development: This new activity supports and coordinates the directorate's activities aimed at strengthening the engineering infrastructure, including education, human resources, instrumentation, and facilities. Among its goals are the following: (1) to increase the effectiveness of engineering education through curriculum revision, instructional development, and strengthened laboratory experiences, (2) to increase the number and quality of engineering professionals available for the next decade by expanding the number of minorities, women, and disabled individuals participating in the profession, (3) to recognize the importance of specialized research and instructional equipment by supporting its acquisition, and (4) to promote cross-disciplinary activities. Among the programs sponsored in 1991 will be two new engineering education coalitions, bringing the total number funded by NSF to five, new pilot projects to develop model undergraduate courses, activities to expand the participation of undergraduate women and minorities in engineering research, and efforts to initiate studies, workshops, and conferences to promote the participation of underrepresented minorities in engineering.

Engineering centers: Engineering research centers (ERC) emphasize the development of long-term strategic research leading to technological advances and an improved understanding of the integration and management of engineering systems. Emphasis is placed on involving graduate and undergraduate students in the programs. Currently there are 19 centers established in universities across the country. The centers specialize in the areas of manufacturing and design, materials processing for manufacturing, optoelectronics, microelectronics, and telecommunication, biotechnology and bioengineering, and resource recovery and utilization and infrastructure. No new ERCs are planned for 1991; support will be strengthened for existing centers. By the end of 1990 there also will be 48 operational industry/university cooperative research centers. This program encourages industry/university cooperation by developing programs defined by the industries supporting each center. Several new centers are proposed in this program in 1991.

Computer and information science and engineering

The computer and information science and engineering directorate (CISE) supports research to improve fundamental understanding of computing and information processing, promotes human resource development to contribute to and exploit new knowledge, and supports the operation of advanced national facilities for supercomputing and computer networking.

The 1991 request for research funding for the CISE directorate is $177 million, a 15-percent increase over 1990. CISE is proposed to receive 9 percent of NSF research funding. Research activities in the areas of software development, high performance software systems, and collaboration technology will receive special emphasis. In addition, multidisciplinary research projects will be initiated in two areas of high leverage for all of scientific and engineering research: scientific databases and application-specific computing systems. Funds will also be allocated for operation and upgrade of national supercomputer centers, operation and upgrade of NSFNET, and instrumentation in support of research.

Advanced scientific computing: Four national supercomputing research centers and basic research on methods and technologies for high performance scientific computing continue to receive support. Although support has been withdrawn from one supercomputer center, the upgrades at the remaining four effectively double the overall capacity of the NSF supercomputer program. Research will be supported to develop automated tools for improvement of user software and to provide users with a more robust computing environment.

Networking and communications research and infrastructure: This program supports the development and operation of a general purpose computer network for supercomputer access, and fundamental scientific and engineering research on communications theory and network design. NSFNET provides access to the NSF supercomputer centers for the national computational science community. Additional research funding will be used to increase the number of awards for disciplinary fundamental research, sponsor additional work in the network technology component of the program in coordination theory, and promote the coordinated interagency program of research and technology demonstration in networks operating at speeds in excess of a billion bits per second.

Computer and computational research: The 1991 request increases emphasis on fundamental software research. Previous efforts in parallel and distributed systems and scientific computing will be focused on the problems of high performance computing. Additional support will be given to basic research on methods of software creation. New research will be started in software for use in application-specific computing systems.

Information, robotics, and intelligent systems: Base support in all program elements will be maintained to take advantage of computing technologies such as new sensors, parallel computers, and high bandwidth communication networks. Two priority areas will be scientific databases and collaboration technology. Collaboration technology research is designed to improve

R&D budget authority for computer and information science and engineering
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$138	$154	$177	15.0%
Advanced scientific computing	43	48	48	-0.4
Computer and computational research	21	22	24	10.5
Information, robotics, and intelligent systems	19	20	23	14.5
Networking and communications research and infrastructure	18	22	31	41.0
Microelectronics information processing systems	15	17	19	13.6
Cross-disciplinary activities	17	20	24	22.4
Science and technology centers	5	6	8	41.9

SOURCE: National Science Foundation, SRS

methods of using information technologies to improve coordination, communication, and resource management of human collaborative activity to allow humans to function more efficiently in distributed workplaces.

Microelectronics information processing systems: A major goal of this program is to produce the knowledge and mechanisms necessary for the economical and simplified creation of special purpose information processing and computing devices. An application-specific computing systems (ASCS) initiative will support research in several areas: (1) designing and evaluating special purpose computing architectures, (2) improving design techniques and knowledge associated with ASCS design, (3) building and evaluating experimental systems to validate newly developed design techniques, (4) improving services for fabricating chips, boards, and systems for rapid prototyping, and (5) supporting interdisciplinary research that brings together application expertise and computing system designers.

Cross-disciplinary activities: The request for 1991 continues to increase a variety of research and educational infrastructure and human resource building programs. Particularly noteworthy is the further expansion of support for research activities at minority institutions.

U.S. Antarctic program

The U.S. Antarctic program works to protect the ecological viability of the continent, foster cooperative research, and ensure the equitable and wise use of the region's resources. The program supports research on topics that contribute directly to the NSF global geosciences program.

The 1991 funding request for research activities in the Antarctic program is $153 million, a 14-percent increase over 1990. The Antarctic program is proposed to receive 8 percent of NSF research funding. The major multi-year safety, environment, and health initiative which began in 1990

R&D budget authority for U.S. Antarctic program
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-91
Total	$118	$135	$153	13.5%
Operations support program	88	99	110	10.7
Major construction and procurement	14	18	24	30.3
U.S. Antarctic research program	16	17	19	11.7

SOURCE: National Science Foundation, SRS

will be expanded significantly in 1991. The goals of this program are as follows: to achieve year-round operations in the Antarctic with modern technology and acceptable risk; to clean up the debris of past operations and to bring present operations into accord with current regulations; and to improve medical facilities and to provide field parties with safety experts who have medical training.

Operations support: Conduct of research in the Antarctic involves costs which directly support scientific research as well as the costs of continuing services that underpin a U.S. presence in the region. Research costs include operation of research ships, aircraft, and land-based research stations. Funding for all aspects of ongoing support activities is proposed to increase and a second research vessel is being obtained to provide a platform for operations in ice too heavy for the research vessel Polar Duke. Funds also are provided for short-term charter of a specialized research vessel for antarctic geophysics.

Major construction and procurement: Projects related to the safety, environment, and health initiative will receive increased funding. Initiative-related increases include funds for fuel storage improvements, South Pole Station design, the McMurdo Station incinerator, a hazardous waste storage facility, Palmer Station rehabilitation, navigational aids for aircraft and field parties, and improved ground transportation.

U.S. Antarctic research program: Research across the disciplines applicable to Antarctica will be continued with some changes in emphasis. Increased funding will provide for an additional long-term ecological research project, progress on a large-scale geophysics program, and continued expansion of ocean research. Seasonal depletion of ozone and ecological interactions in the Antarctic will continue to be major areas of concern.

Scientific, technological, and international affairs

The scientific, technological, and international affairs directorate (STIA) is responsible for cross-disciplinary activities which satisfy requirements for scientific and technological excellence and broader objectives related to the national and international science and technology infrastructure. STIA programs are often experimental in nature and many are designed to promote interactions among different sectors of the economy.

The 1991 request for research funding for STIA is $68 million, a 17-percent increase over 1990. STIA is proposed to receive 3 percent of NSF research funding.

Research initiation and improvement: Funding is directed toward removing barriers that inhibit full participation of individuals, institutions, and regions in the Nation's science and technology effort. Programs are designed to have an impact in several areas: (1) improved access to resources by institutions and States whose participation in science and engineering research and education are below the national average, (2) increased research opportunities for underrepresented minorities and faculty from predominately undergraduate institutions, and (3) a strengthened and diversified human resource and institutional base in science and technology. Research initiation and improvement is responsible for five programs:

Research Careers for Minority Scholars, Visiting Professorships for Women, Research Improvement in Minority Institutions, Minority Research Centers of Excellence, and Experimental Program to Stimulate Competitive Research (EPSCoR).

Industrial science and technological innovation: This program has primary responsibility for the small business innovation research program (SBIR). It is expected that more than 1,625 proposals will be submitted for consideration in 1991. An increase of $2.5 million maintains the SBIR at the legislatively mandated 1.25 percent of NSF's extramural research. A new program to facilitate the transfer of new technology-related knowledge derived from academic research results will be initiated. It is expected that the college and university innovation research program, modeled after the SBIR program, will make 16 awards in 1991 with STIA funds matched by funds from other NSF directorates.

International cooperative scientific activities: Support for international cooperative programs that substantially benefit U.S. science and engineering is the focus of this program. Objectives of the program are to increase the access of U.S. scientists and engineers to research facilities abroad, coordinate NSF participation in cooperative international scientific agreements, and manage NSF participation in international and multilateral organizations. Additional funding in 1991 will be used to continue ongoing programs as well as to link researchers with their counterparts in Eastern Europe though competitive grant programs and to implement the memorandum of understanding between the Foundation and the U.S.S.R. signed in 1989.

R&D budget authority for scientific, technological, and international affairs
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$54	$58	$68	17.0%
Research initiation and improvement	23	26	32	23.5
Industrial science and technological innovation	19	20	23	14.4
International cooperative scientific activities	11	11	12	7.5
Policy research and analysis	(a)	(a)	(a)	0.0
Science resources studies	(a)	(a)	(a)	30.0

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Science and engineering education

The responsibility of the science and engineering education directorate (SEE) is to define and fund programs and projects that support the educational aspects of NSF's mission. Funding for research activities in SEE is proposed to rise by 4 percent to over $16 million in 1991.

Materials development, research, and informal science education: Efforts are directed toward increasing the quality of science, mathematics, and technology education at all precollege levels by improving the instructional materials and teaching methods used in the classroom and by enriching the environment for informal learning outside the school.

Studies and program assessment: Increased funding is proposed for national and international comparative studies of science education, policy studies related to education improvement and reform initiatives at the local level, and assistance to states and local districts to develop effective evaluation methods.

Teacher preparation and enhancement: Among the proposed foci of 1991 research activities are the continuing development of methods for accelerating the application of new teaching technologies, such as computers, and the development of teaching strategies that enhance the interest of underrepresented minorities in science and engineering.

R&D budget authority for science and engineering education
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$15	$16	$16	4.5%
Materials development, research, and informal science education	10	11	12	3.6
Studies and program assessment	4	4	4	8.3
Teacher preparation and enhancement	1	1	1	0.0

SOURCE: National Science Foundation, SRS

Department of Energy

DOE's general science programs support basic research in areas that are expected to have a long-term impact on energy development and utilization. Research on high energy physics and nuclear physics is supported through direct funding of individual projects and for research-related activities at numerous user facilities.

Funding for DOE's general science programs is proposed to increase by 13 percent, to $830 million, in 1991. This funding is in support of basic research, both at national physics laboratories and related to the Superconducting Super Collider.

R&D budget authority for the general science programs of the Department of Energy
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$703	$733	$830	13.1%
High energy physics	431	463	494	6.8
Facility operations	246	260	279	7.1
Physics research	122	131	140	7.0
High energy technology	63	72	75	5.0
Nuclear physics	187	198	216	8.6
Medium energy nuclear physics	85	92	101	9.3
Heavy ion nuclear physics	66	68	73	8.0
Low energy nuclear physics	24	26	28	6.7
Nuclear theory	11	12	14	10.4
Superconducting Super Collider	82	68	110	62.1
Program direction	3	4	10	150.9
Superconducting Super Collider	1	1	6	580.2
General science programs	3	3	4	31.3

SOURCE: National Science Foundation, SRS

High energy physics

The primary activities of the high energy physics program for 1991 involve the use of two recently upgraded facilities: (1) the new electron-positron collider with the improved time projection chamber detector at the Stanford Linear Accelerator Center, and (2) the Tevetron proton-antiproton collider and just completed D-Zero detector at the Fermi National Accelerator Laboratory. Additional elements are pursuit of long-range accelerator and detector R&D studies to develop new and advanced concepts, funding for continued effective participation of university scientists, and planning of experiments for the Superconducting Super Collider.

Specific projects include initiation of research operations for colliding beam physics research and analysis of fixed target program data already taken at Fermi National Accelerator Laboratory. At the Stanford Linear Accelerator Center, completion of major facilities will enable research groups to study Z zero and other physics in this energy region. More precise studies of rare kaon decay and proton-proton elastic scattering with the polarized beam will be undertaken at Brookhaven National Laboratory as will early beam tests of the muon anomalous magnetic moment (g-2) experiment. An important part of Brookhaven research will be devoted to the scheduled first operation of the D-Zero experiment at Fermilab. Researchers from other laboratories and universities and colleges will participate in, and analyze data from, these experiments, and those conducted at physics facilities around the world. Since the limits of present accelerator technology are being reached by present generation machines, the high energy technology program will focus on a search for new accelerator technologies.

Nuclear Physics

The nuclear physics program conducts basic research and tests theoretical predictions on the structure and interaction of atomic nuclei and the fundamental forces and particles of nature as they manifest themselves in nuclear matter. Over 75 percent of the scientists supported by the program plan experiments and conduct research at large user-dedicated laboratories. These facilities include the Bevalac at Lawrence Berkeley Laboratory, the Tandem/AGS high energy heavy ion beams at Brookhaven National Laboratory, the Los Alamos Meson Physics Facility, the Continuous Electron Beam Accelerator Facility, and the ATLAS superconducting heavy ion facility at Argonne National Laboratory. Increased research support will be given to students and postdoctoral fellows to accommodate growing interest in nuclear physics and to enhance theoretical work.

The medium energy nuclear physics program supports research on scattering of pions and protons, weak interactions, muonic and pionic atoms, selective excitation of proton/neutron states, and giant resonances. Research activities required for the Continuous Electron Beam Accelerator Facility are also carried out under this program. The heavy ion research program supports studies of the behavior of nuclear matter over an increasing range of excitation energy, nuclear density, angular momentum, and deformation. Some consolidation of low energy activities at national laboratories is planned. The low energy nuclear physics program emphasizes experimental investigations of nuclear structure, nuclear decay parameters and low energy reaction mechanisms. The nuclear theory program interprets results from experiments and predicts phenomena and relationships in order to develop a comprehensive understanding of the foundations of nuclear matter at the most fundamental level.

Superconducting Super Collider

The Superconducting Super Collider (SSC) is a high luminosity proton-proton collider having an energy of 20 trillion electron volts (Tev) per beam. The request for 1991 includes a 62-percent increase in funding for research in the following areas: accelerator systems and detectors, including continued research on industrialization of magnet fabrication; advancing the conceptual design of the injector, quadrupole, and correction magnets and other technical systems; optimizing the design of the superconducting dipole magnets; and providing input for refining the design of conventional facilities. Research funds also will be used to support a major enhancement of detector research as specific detector designs evolve.

ENERGY

The following three agencies provide support for R&D efforts in energy (function 270): the Department of Energy, the Nuclear Regulatory Commission (NRC), and the Environmental Protection Agency (EPA).

Within the energy function, R&D activities in 1991 will emphasize the following themes: the management of DOE facilities in an environmentally safe manner; the conservation of energy and energy efficiency in homes, buildings, transportation, and industry; securing future energy supplies by developing alternatives to the use of oil and promoting increased use of indigenous resources; and fortifying foundations by maintaining scientific and technological preeminence.

Proposed budget authority for energy R&D activities will decrease 5 percent, or $150 million, to $2.8 billion in 1991. This is attributable to reductions in the following R&D activities of the Department of Energy and the Environmental Protection Agency.

- An overall decrease of $299 million is expected for fossil energy, with large reductions proposed for coal R&D.
- Funding for clean coal technology is expected to decrease between 1990 and 1991 because Congress has established a pattern for clean coal technology R&D funding which is spread out over the time frame in which these funds will be needed.
- A decrease of $19 million is scheduled for the R&D programs of the Environmental Protection Agency.
- A decrease of $14 million is proposed for R&D programs on energy conservation.

The reductions are offset by increases for selected DOE programs.

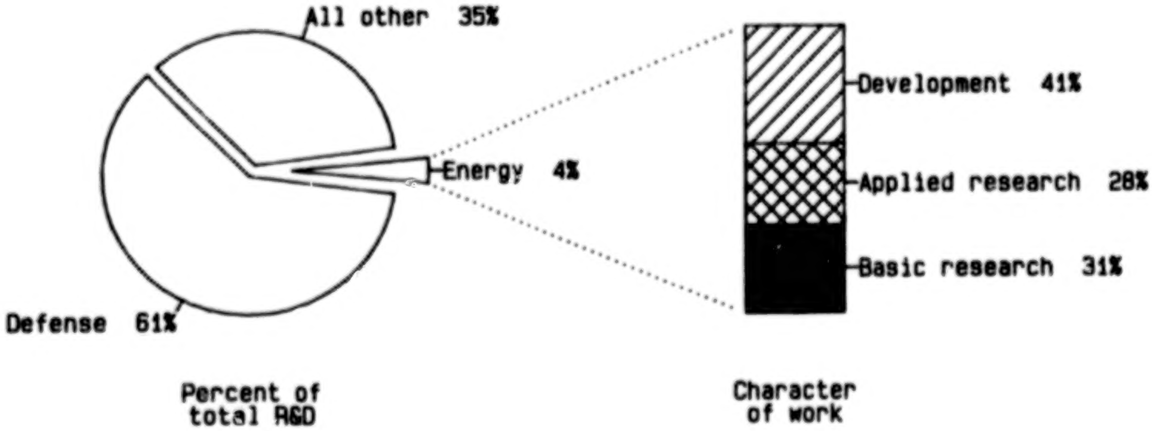
- A $52 million increase is expected for R&D programs in the supporting research and technical analysis programs, primarily in the basic energy sciences.
- An increase of $49 million is proposed for biological and environmental research, primarily for the human genome project.
- A $32 million increase is planned for R&D on solar and other renewable energy.

R&D budget authority for energy
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$2,419	$2,911	$2,761	-5.1%
Department of Energy	2,249	2,768	2,630	-5.0
Fossil energy	544	951	652	-31.4%
Supporting research and technical analysis	446	490	542	10.6%
Biological and environmental research	218	275	324	17.6%
Nuclear fission	318	297	310	4.3%
Magnetic fusion	314	288	292	1.3%
Energy conservation	144	181	167	-8.0%
Solar and other renewable energy	141	134	166	23.9%
Uranium enrichment	117	123	147	18.8%
Environmental restoration and waste management	8	28	31	12.4%
Nuclear Regulatory Commission	115	109	116	6.3%
Environmental Protection Agency	55	33	14	-57.2%

SOURCE: National Science Foundation, SRS

R&D budget authority for energy: 1991



SOURCE: National Science Foundation, SRS

Fossil energy

The 1991 R&D budget authority request of $652 million for fossil energy is $299 million, or 31 percent, less than the 1990 level. The fossil energy program focuses on enabling the effective extraction of, and the clean and efficient use of the nation's supplies of fossil fuels.

The clean coal technology program is a government/industry co funded effort to demonstrate advanced concepts for using coal cleanly, efficiently, and economically. The program was begun and expanded in response to a proposal by the U.S. and Canadian Special Envoys on acid rain. Congress has established a funding pattern for this program spread out over the time frame in which the funds will be needed. The funding in 1991 completes projects selected in the second and third rounds and begins funding for the fourth round of this five-round program. The program requires at least 50 percent cost sharing by industry. To date industry has, in fact, provided more than 60 percent of the funding for the 39 projects that are part of the program. This program will take the best and most promising coal-based processing and emissions control technologies and move them from proof-of-concept stage into the commercial marketplace.

R&D funding for the coal program is expected to drop sharply by $165 million to $110 million in 1991, a decrease of 60 percent. Reduced funding levels are proposed for all subprograms, except for the advanced research and technology program, which is scheduled to increase slightly in 1991 and the magnetohydrodynamics program which is scheduled for termination. Despite the reductions, the coal program will continue to conduct research with a major thrust in technologies that can reduce the release of pollutants as well as technologies which can open up new markets for coal and coal products. Acid rain technology improvements continue to be emphasized in this program. In addition, a number of new technologies are being developed to allow coal to be used more efficiently thereby reducing emissions of carbon dioxide.

The petroleum R&D program in 1990 is proposed for an overall increase of $1 million while the enhanced oil recovery and oil shale activities are scheduled for decreased funding; this more than offsets the funding increases in the advanced extraction and process technology program which is expected to rise by $9 million to $13 million. This program concentrates on improving the knowledge of reservoir characteristics and fluid flow, and using this information to improve the technical and environmental predictability and economic performance of advanced extraction technologies. Funding in 1991 includes an initiative to support a regional/reservoir research program (jointly funded with consortia of States, universities, and private firms).

R&D budget authority for unconventional gas recovery will decrease 5 percent to $14 million in 1991. The goal of this program is to assist the private sector in developing cost-effective diagnostic and extraction technologies to produce gas efficiently and economically from unconventional gas resources.

R&D budget authority for fossil energy
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$544	$951	$652	-31.4%
Clean coal technology	188	554	456	-17.7
Cooperative agreements				
Round 2	174	135	200	48.1
Round 3	-	397	156	-60.7
Round 4	-	-	75	**
Program direction	14	23	25	11.1
Fossil fuels	356	397	197	-50.5
Coal	242	275	110	-59.9
Control tech. and coal preparation	49	58	34	-41.8
Advanced research and technology	26	26	27	0.4
Combustion systems	27	33	18	-47.0
Coal liquefation	32	35	11	-69.3
Surface coal gasification	21	23	9	-63.4
Fuel cells	26	38	7	-81.3
Heat engines	23	21	6	-71.3
Underground coal gasification	1	1	1	-78.6
Magnetohydrodynamics	37	40	-	*
Petroleum	38	40	41	2.0
Enhanced oil recovery	24	27	27	-0.7
Advanced extraction & process tech.	4	4	13	258.3
Oil shale	11	9	1	-92.2
Gas--unconventional gas recovery	11	14	14	-4.9
Program direction	65	68	32	-53.4

* Proposed for elimination.
** Proposed new funding.

SOURCE: National Science Foundation, SRS

Supporting research and technical analysis

In 1991, an increase of $52 million, or 11 percent, to $542 million is scheduled for supporting research and technical analysis. These programs focus on the areas of fundamental science that have the greatest potential impact on energy production; the assessments of energy-related technologies that have potentially high payoffs in the future: and the training of professionals in energy-related activities. The principal program is basic energy sciences which accounts for 93 percent of funding in this area.

The basic energy sciences program will increase by $47 million to $504 million in 1991. This program is responsible for generic long-term research in nuclear and non-nuclear energy technologies. This program focuses on the development of new technologies and improvements to existing technologies. The funding is grouped in six major scientific disciplines. All of the R&D activities within this program are scheduled to increase in 1991, except for engineering and geosciences, and energy biosciences which are expected to decline slightly in 1991. Research in the area of advanced energy projects is receiving increased emphasis in 1991.

R&D budget authority for supporting research and technical analysis
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$446	$490	$542	10.6%
Basic energy sciences	416	457	504	10.3
Materials sciences	174	199	222	11.7
Chemical sciences	128	140	151	7.3
Applied mathematical sciences	42	44	48	9.8
Advanced energy projects	14	15	24	64.4
Engineering and geosciences	33	33	33	-2.1
Energy biosciences	20	21	20	-1.9
Program direction	5	5	7	20.4
University and science education	21	25	30	19.7
University research instrumentation	5	5	5	0.0
Energy research analysis	4	4	4	-2.6

SOURCE: National Science Foundation, SRS

University and science education will increase 20 percent to $30 million in 1991 and university research instrumentation is scheduled to remain unchanged at $5 million. These two programs are the primary mechanisms used by DOE to strengthen the institutional capabilities of universities and colleges as the agency's contribution to long-range R&D efforts and to ensure that the Nation's science education system adequately prepares young students for careers in science and engineering. Energy research analysis is proposed to remain at about $4 million in 1991. This program provides the capability for undertaking independent technical assessments of DOE research programs.

Biological and environmental research

Biological and environmental research is expected to increase $49 million, or 18 percent, to $324 million in 1991. This program represents the Nation's only long-term research effort specifically focused on energy-related health and environmental issues. These R&D efforts seek (1) to identify, understand, and anticipate the long-term health and environmental consequences of energy use and development, and (2) to employ DOE's scientific and technological capabilities to solve major scientific problems in medicine and biology.

R&D budget authority for biological and environmental research
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$218	$275	$324	17.6%
General life sciences	45	56	80	42.7
Human genome	18	26	46	76.5
Molecular biology	13	13	14	7.5
Structural biology	7	8	10	23.8
Cellular biology	9	8	10	13.1
Health effects	65	72	73	2.2
Carbon dioxide research	17	50	66	31.8
Environmental	36	41	45	10.4
Medical applications	36	37	37	-0.8
Analytical technologies	14	15	17	11.8
Program direction	4	5	6	28.9

SOURCE: National Science Foundation, SRS

Funding in 1991 will emphasize work on (1) the human genome and the general life sciences, (2) the health effects of exposure to radiation and hazardous substances, (3) new measurement concepts and dosimetry to better characterize such exposures to humans and the environment, (4) environmental research, including subsurface microbiology, (5) radon, and (6) research into the effects of carbon dioxide buildup in the environment.

In 1991, general life sciences research will receive increased emphasis and funding will rise from $56 million to $80 million. The human genome project is being recognized as one of modern biology's most significant initiatives. Research will focus on expanded efforts to develop advanced technology to characterize the molecular nature of DNA, the development of required computer databases, networks and analytical tools, and continued construction of physical maps of human chromosomes in the form of linearly ordered, overlapping DNA fragments. A particular emphasis is on the understanding of processes by which DNA damage is repaired in humans. Funding for the human genome program, the largest activity within general life sciences research, is expected to increase to $46 million in 1991. Other general life sciences research will focus on the molecular, cellular, and structural nature of living systems.

Health effects activities are scheduled for a small increase in 1991 to $73 million. Emphasis is on a scientifically sound database for evaluating the potential adverse health effects that could result from exposure to radiation and chemical agents most relevant to DOE programs.

The carbon dioxide research program is expected to increase to $66 million in 1991. This program is DOE's principal activity in the U.S. Global Change Research Program. Understanding of the role of clouds and radiation in the climate systems will be an objective of this program. This will lead to a better understanding of the magnitude, timing, and regional effects of any global climate change.

Activities under environmental research are scheduled to grow to $45 million. This activity addresses the transport of discharges and their behavior through the atmosphere at different spatial scales and over different time sequences. Research will focus on the exposure of these materials to the environment and the resiliency of biological systems to disturbance.

Nuclear fission

The goals of the nuclear energy R&D program are (1) the establishment of a predictable regulatory and institutional environment that enables nuclear power to compete freely in the marketplace, (2) the support of industry efforts to revitalize the light-water reaction option in the United States, (3) the exploration of the feasibility of advanced nuclear reactor systems, (4) the support of international nuclear R&D projects, (5) the strengthening of the U.S position in international commerce, (6) meeting long-term needs in uranium enrichment, and (7) conducting development programs on compact space and terrestrial nuclear power systems.

Nuclear energy R&D is expected to increase $13 million, or 4 percent, to $310 million. Increased funding is proposed for advanced radioisotope power systems, space reactor power systems, and light water reactors. The increases in these programs are partially offset by declines in the test facilities R&D and the advanced reactor R&D programs.

The largest program, test facilities R&D, is expected to receive a $25 million decrease to $131 million. This program provides safe, reliable, and economical testing capabilities for the development of nuclear power systems for space, defense, and civilian applications. Emphasis will be on R&D efforts on testing steam generators that could provide the Nation and the international community with a reliable component in the utilization of sodium cooled reactor technology.

Advanced radioisotope power systems (formerly entitled advanced nuclear systems) funding is expected to increase to $56 million. This program provides support for radioisotope power source development, demonstration, testing and production. Radioisotope power sources are the enabling technologies for space and terrestrial applications requiring proven, reliable, and maintenance-free power supplies capable of producing significant kilowatts of power and operating under severe environmental conditions for up to ten years.

R&D budget authority for nuclear fission
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$318	$297	$310	4.3%
Nuclear energy R&D	317	297	310	4.3
Test facilities R&D	126	156	131	-15.9
Advanced radioisotope power systems	30	30	56	86.2
Advanced reactor R&D	73	57	45	-20.8
Space reactor power systems	53	22	38	75.9
Light water reactors	27	24	32	29.1
Program direction	9	9	9	1.1
Remedial action and waste technology	1	-	-	*

* Scheduled for termination.

SOURCE: National Science Foundation, SRS

The advanced reactor R&D program's funding is expected to drop significantly from $57 million to $45 million. This program supports the development of highly innovative reactor systems with the potential for breakthroughs in economics, safety, licensability, and waste management. Support will continue for the modular high-temperature reactor and the liquid-metal reactor.

The space reactor power systems (formerly space and defense power systems) program designs nuclear reactors which will provide higher output to meet future civilian and military requirements. This program will increase to $38 million in 1991.

The light water reactors R&D effort supports industry-led efforts to revitalize light water technology as a vital component of the national energy base to meet electricity demands.

Magnetic fusion

R&D budget authority for magnetic fusion shows an increase of $4 million, to $292 million in 1991. This is primarily attributable to the proposed increase in funding for the confinement systems program. The long-term need for magnetic fusion as an energy supply system remains strong because it is a source that is secure and environmentally acceptable. Fusion fuels are inexhaustible and fusion has the potential to create energy safely without the creation of radioactive wastes.

The 1991 budget request for magnetic fusion supports the development of fusion power as a future energy option and provides funding for the support of domestic and international initiatives. Research efforts will continue for the Compact Ignition Tokamak, and the proposed International Thermonuclear Experimental Reactor (an international engineering fusion test reactor) within the confinement systems program.

Confinement systems, the largest program within magnetic fusion, is expected to grow to $163 million. This increase is attributable to more funding for the base toroidal systems program, which is expected to increase to $65 million. The advanced toroidal systems program is expected to rise to $23 million in 1991.

The applied plasma physics program is scheduled to decrease $1 million, to $71 million. These funds will be focused on research that lead to an improved understanding of physics and to develop innovative techniques to be used in ignition and reactor design.

The development and technology program is proposed at $48 million in 1991. The program supports the development of technologies needed for present and future experiments, and for the design and analysis of fusion systems.

R&D budget authority for magnetic fusion
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$314	$288	$292	1.3%
Confinement systems	173	160	163	1.8
Base toroidal	61	60	65	8.4
Tokamak fusion test reactor	67	61	58	-4.3
Advanced toroidal	23	17	23	39.5
Compact ignition tokamak	15	17	17	-2.9
Major device fabrication	5	3	(a)	-88.2
Tandem mirror operations	2	3	-	*
Applied plasma physics	81	72	71	-1.0
Experimental plasma research	21	25	24	-4.0
Fusion plasma theory	21	19	20	1.0
National MFE computer network	18	15	16	1.3
Advanced fusion concepts	22	12	12	-0.8
Development and technology	54	47	48	1.3
Fusion technologies	23	21	21	1.9
Plasma technologies	20	15	15	2.8
Fusion systems analysis	11	12	12	0.0
Planning and projects	1	4	4	2.4
Program direction	5	5	6	16.3

* Proposed for termination.
(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Energy conservation

Energy conservation is scheduled for a reduction of $14 million, or 8 percent, to $167 million in 1991. This program supports research in areas of energy conservation where new knowledge can expand the technology base to use energy economically.

Transportation R&D funding for energy conservation is proposed at $56 million. Most of the major transportation programs in energy conservation will decrease in 1991. The vehicle propulsion and electric hybrid vehicle R&D programs are expected to experience the largest declines. The alternative fuels utilization program will receive increased funding in 1991, to $11.5 million. The remaining programs in transportation focus on research efforts to improve the energy efficiency of vehicle systems with increased emphasis on advanced materials development such as ceramics.

The buildings and community systems program is the only R&D program within energy conservation that is expected to increase in 1991. R&D efforts in this program focus on components and design technologies that will improve the thermal integrity of buildings and on technologies that will increase the energy efficiency of building heating, cooling, lighting, and water heating equipment. The building systems subprogram, the Federal energy management subprogram, and the technology assessment and transfer subprogram are all scheduled for increases in 1991.

Industrial R&D programs are scheduled to decrease by $11 million to $40 million in 1991. These programs support research and development activities that (1) increase end-use energy efficiency and productivity of industrial operations, (2) facilitate the use of the most cost effective and efficient fuels, and (3) ensure that developed technologies conform to safety, health, and environmental requirements. The declines result from reductions in all R&D activities except the implementation and deployment subprogram where funding is expected to increase to $4.2 million.

The 1991 budget authority reflects a reduced request of $26 million for multisector R&D programs. The multisector R&D program supports crosscutting efforts in combustion, thermal sciences, materials, biocatalysis, and tribology (friction/wear and lubrication) technologies. Objectives include the development of new high-temperature materials that possess high corrosion resistance and strength, and improved high-temperature lubricants. Long-term R&D efforts are focused on engines with a modified combustion process to burn a wide variety of fuels cleanly, and new biotechnology efforts to remove carbon dioxide and other greenhouse gases from combustion exhaust streams.

R&D budget authority for energy conservation
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$144	$181	$167	-8.0%
Transportation	54	63	56	-12.0
Buildings and community systems	34	38	45	18.8
Industrial	30	51	40	-21.2
Multisector	26	29	26	-10.7

SOURCE: National Science Foundation, SRS

Solar and other renewable energy

R&D budget authority for solar and other renewable energy is expected to increase 24 percent, or $32 million, to $166 million in 1991. This functional activity is comprised of the following four programs: solar energy, electric energy and energy storage systems, geothermal energy, and hydropower.

The solar energy R&D program is designed to support generic and long-range research on a variety of alternative energy technologies that offer a diversification of supply that can satisfy energy demands in all common forms used throughout the economy. In 1991, solar energy R&D will focus Federal resources on the highest payoff opportunities with a balanced effort between applied research and development necessary to attract capital and industrial commitments needed to exploit and expand the use of these energy supply technologies. Most major activities will receive increased funding in 1991. R&D for photovoltaic energy systems, the largest solar energy program, is proposed to grow by $9 million to $43 million. This program supports research that involves the direct conversion of sunlight into electricity. Biofuels energy systems research funding emphasizes the development of innovative and economical processes to produce and convert biomass feedstocks into liquid alcohol fuels. Funding for this program will rise by $12 million to $27 million. Solar thermal energy systems will receive a $5 million increase in 1991, to $19 million. The objective of solar thermal energy systems is to establish a technology base from which industry can develop solar thermal power production options for introduction into utility and industrial energy markets. Wind energy systems research will focus on understanding the sources of wind variability, interaction between wind input and wind turbines, and the use of advanced components and subsystems for improved performance.

R&D budget authority for electric energy systems and energy storage systems is scheduled to increase $9 million in 1991. These programs direct research toward solving electric energy transmission and distribution problems, and increasing the efficiency of the energy economy. Emphasis in 1991 is on applied high temperature superconductivity research for increasing the efficiency of electric power generation, transmission, distribution, and storage.

Geothermal energy R&D programs are expected to remain unchanged at $18 million in 1991. The objective of this program is to work with the private sector in developing reservoir, building, and commercial technologies to exploit the multimegawatt potential of hydrothermal electric power. All except two activities are expected to receive some increases in funding. Geopressured research is scheduled for a 51-percent reduction to $3 million and the magma energy program is proposed for elimination.

R&D budget authority for solar and other renewable energy

[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$141	$134	$166	23.9%
Solar	86	87	109	25.1
Photovoltaic energy systems	34	34	43	26.6
Biofuels energy technology	13	16	27	74.2
Solar thermal energy technology	15	15	19	30.2
Wind energy systems	8	9	8	-5.6
Solar technology transfer	2	2	2	22.2
Solar international programs	1	1	2	50.0
Solar buildings technology	2	1	1	-9.1
Resource assessment	1	1	1	25.0
Ocean energy systems	4	4	-	*
Program direction and support	5	5	5	6.0
Electric energy and energy storage systems	36	30	39	31.2
Electric energy systems	24	18	26	45.8
Energy storage systems	12	12	12	2.5
Program direction	1	1	1	22.2
Geothermal	19	18	18	0.0
Reservoir technology	3	2	4	90.5
Hot dry rock research	4	3	4	5.9
Hard rock penetration research	2	2	3	54.5
Geopressured research	6	6	3	-50.8
Conversion technology	2	2	3	86.7
Magma energy	2	2	-	*
Program direction	1	1	1	12.5
Hydropwer	-	-	1	**

---

* Proposed for termination.

** Proposed new funding.

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Uranium enrichment

Uranium enrichment is scheduled to increase 19 percent to $147 million in 1991. The goal of this program is to conduct research in support of the U.S. Government's requirement to provide domestic and foreign uranium enrichment services in the most economical, reliable, safe, secure, and environmentally acceptable manner possible. Uranium enrichment R&D activities are all conducted under the Atomic Vapor Laser Isotope Separation (AVLIS) program. A main objective of this program is to develop an advanced technology option that can enrich uranium at a cost significantly less than the uranium produced at gaseous diffusion plants and by foreign competitors. An objective of this program is to develop the uranium enrichment enterprise into a financially healthy business enterprise.

In 1991, funding for all major subprograms is expected to increase. Major R&D efforts include activating the laser systems which have been brought on line. An additional $15 million is proposed for the R&D activities of the uranium separators program related to the support of uranium vaporization testing. The uranium processing program will receive increased funding to complete the development of a feed and product conversion demonstration facility.

R&D budget authority for uranium enrichment
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$117	$123	$147	18.8%
Atomic Vapor Laser Isotope Separation	117	123	147	18.8
Lasers	45	48	57	19.1
Uranium separators	39	39	54	38.7
Systems integration	20	21	22	4.3
Uranium processing	8	8	11	29.3
Technology transfer and analysis	1	3	3	0.0
Process development and pre-deployment planning	5	5	1	-87.8

SOURCE: National Science Foundation, SRS

Environmental restoration and waste management

R&D support for environmental restoration and waste management is expected to increase 12 percent to $31 million in 1991. This program is the cornerstone of the Department's long-term strategy to consolidate and coordinate DOE's cleanup activities. The environmental restoration and waste management program spans two functions, the defense function and the energy function. The dollar amount reported in this section reflects funding provided under the energy function. The funding provided for the portion of this program that is defense-related is presented under the national defense function. This five year plan consolidates three specific compliance related activity areas. "Corrective Activities" denote actions necessary to bring facilities into compliance with applicable government regulations. "Environmental Restoration" includes the assessment and cleanup of surplus activities and inactive sites. "Waste Management Operations" involve the treatment, storage, and disposal of wastes generated as a result of ongoing operations at active facilities.

Nuclear Regulatory Commission

The 1991 request for NRC is $116 million, or $7 million more than in 1990. The Office of Nuclear Regulatory Research has the authority and the responsibility under the Energy Reorganization Act of 1974 to conduct research in support of the nuclear regulatory process. The primary benefits of nuclear safety research are improved regulations through better definition and refinement of safety margins, anticipation of operational problems, and tools to deal with safety issues as they arise.

R&D budget authority for the Nuclear Regulatory Commission
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$115	$109	$116	6.3%
Integrity of reactor components	33	31	33	6.8
Reactor containment and protection	29	26	28	10.6
Developing regulations and resolving safety issues	24	26	26	2.4
Preventing damage to reactor cores	21	19	19	2.1
Confirming safety of waste disposal	8	8	9	13.3

SOURCE: National Science Foundation, SRS

Integrity of reactor components funding is expected to increase to $33 million in 1991. This program examines reactor systems and related components to determine whether they perform as designed and ensures that the functional integrity and operability of the systems can be maintained over the life of the plant. This program consists of four major activities: (1) reactor vessel and piping integrity, (2) aging of reactor components, (3) engineering and standards support, and (4) seismic and fire protection. The increase in 1991 funding is for pressure vessel safety irradiation tests and studies associated with piping and support structure behavior, studies of the effects of aging on nuclear power plant operations, and for the evaluation of the effects of potential earthquakes on nuclear plant operations.

Reactor containment and performance funding is expected to increase to $28 million in 1991. This program is primarily directed toward protecting the public in the unlikely event of a core-melt reactor accident. These R&D activities include the siting of nuclear plants away from population centers, the inclusion of specially engineered safety systems designed to prevent failure of the containment structure, and development of safety systems to limit the quantities of fission products that might be released if the containment structure were to lose its leak-tight integrity. Major subprograms include the following: core melt and reactor coolant system failure, reactor containment safety, reactor containment structural integrity, and reactor accident risk analysis. Increased funding in 1991 is for research on containment performance during a severe accident.

The developing regulations and resolving safety issues program ensures that resources are directed toward the development of technical and regulatory requirements to protect the health and safety of the public from the generation of electricity and from the possible harmful effects of manufacturing, processing, transporting, and storing nuclear fuel. Major subprograms include the following: generic and unresolved safety issues, standardized and advanced reactors, fuel cycle, materials, and transportation safeguards, developing and improving regulations, severe accident implementation, and radiation protection and health effects.

Research on preventing damage to reactor cores is expected to remain unchanged at $19 million. This program encompasses the operations of the reactor as a system, maintaining water in the reactor system, maintaining core cooling and heat removal, and maintaining proper temperatures and pressures. Major subprograms are plant performance, reactor applications, human factors, reliability assessment, and accident management.

Environmental Protection Agency

Energy-related R&D activities within EPA are expected to decrease by 57 percent, or $19 million, to $14 million in 1991. All energy R&D activities are performed under the multi-media energy research program. The largest activity, acid deposition, is expected to absorb all of the decline in funding for this program. The reduction reflects completion of the National Acid Precipitation Assessment Program and completion of all of the effects research in the acid deposition program. Research activities in environmental engineering and technology are expected to increase slightly, with R&D efforts continuing in the Limestone Injection Multistage Burner (LIMB) control technology program.

R&D budget authority for the energy R&D program of EPA
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$55	$33	$14	-57.2%
Multi-media energy	55	33	14	-57.2
Acid deposition	51	30	11	-64.7
Environmental engineering & tech	4	3	4	8.8

SOURCE: National Science Foundation, SRS

NATURAL RESOURCES AND ENVIRONMENT

R&D activities within natural resources and environment (function 300) are conducted by the Department of the Interior, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, the U.S. Forest Service of the Department of Agriculture, and the Army Corps of Engineers. Research and development activities that fall within this function are viewed as contributing toward the management of public lands and other natural resources for their preservation, conservation, and economic development, as well as encouraging increased knowledge and understanding of the environment.

The proposed R&D budget authority for natural resources and environment is $1.4 billion in 1991. This represents an increase of $46 million, or 3 percent, over 1990. The major subfunctions, pollution control and abatement, conservation and land management, recreational resources, and water resources will all increase in R&D funding in 1991. Elements of proposed funding increases include the following efforts.

- o A total of $434 million is proposed for pollution control and abatement--10 percent more than in 1990. The growth in funding is attributable to an additional $40 million for the R&D activities of the Environmental Protection Agency.

- o Water resources R&D will grow by $18 million in 1991.

    - The Army Corps of Engineers will receive an additional $14 million.

    - The R&D programs of the Bureau of Reclamation will rise by $4 million.

- o R&D support for conservation and land management will grow by an additional $5 million in 1991.

    - The conservation and land management R&D activities of the Department of the Interior are expected to grow by $3 million.

    - The U.S. Forest Service will receive an additional $2 million.

- o The growth of the R&D activities in recreational resources is primarily attributable to the R&D programs of the National Park Service which are proposed to increase by $3 million in 1991.

R&D budget authority for natural resources and environment

[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$1,255	$1,362	$1,408	3.4%
Pollution control and abatement				
Environmental Protection Agency	331	394	434	10.2
Conservation and land management	144	153	158	3.1
Forest Service (USDA)	138	147	149	1.1
Department of the Interior	6	6	9	57.1
Recreational resources	80	91	92	1.5
Fish and Wildlife Service (Interior)	61	71	69	-2.7
National Park Service (Interior)	19	20	23	16.9
Water resources	41	39	58	46.7
Corps of Engineers (DOD)	37	35	49	39.9
Bureau of Reclamation (Interior)	4	4	9	100.0
Other natural resources	659	686	668	-2.7
Geological Survey (Interior)	280	300	305	1.6
National Oceanic and Atmospheric Administration (Commerce)	282	285	284	-0.2
Bureau of Mines (Interior)	96	100	78	-22.6
Office of the Secretary (Interior)	0	1	1	40.0

SOURCE: National Science Foundation, SRS

Pollution control and abatement

The 1991 proposed budget includes $434 million for the pollution control and abatement programs of the Environmental Protection Agency. This growth of $40 million, or 10 percent, over the 1990 level is primarily for funding of interdisciplinary and air quality research. The goals of the research program at EPA are (1) to develop the scientific data necessary for determining the most cost effective and environmentally safe means of achieving the results of EPA's mission, (2) to provide the necessary scientific data in support of the statutory and regulatory responsibilities, and (3) to further the state of knowledge on environmental problems not yet fully understood.

Major emphases in the 1991 budget include: strengthening the agency's long-term research capabilities, enhancing global climate change research, addressing research needs of the President's Clean Air Act legislation, and supporting media program needs.

R&D budget authority for pollution control and abatement
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$331	$394	$434	10.2%
Environmental Protection Agency				
Interdisciplinary	44	94	111	18.6
Air quality	68	81	95	17.7
Superfund/Lust trust fund	74	65	72	10.6
Hazardous waste	44	45	41	-8.2
Water quality	24	28	29	2.8
Toxic substances	28	27	29	4.8
Drinking water	21	22	23	2.7
Pesticides	13	13	15	14.9
Radiation	4	4	4	2.5
Program management and lab support	13	15	15	3.4

SOURCE: National Science Foundation, SRS

Interdisciplinary: Research funding is proposed to increase by $18 million to $111 million in 1991. This subactivity consists of programs that cut across all other R&D activities. They include uniform risk assessment, regulatory development, and technology transfer to the private sector. The uniform risk assessment research activity provides agency-wide guidance to perform exposure and risk assessments based on sound scientific principles and information. The regulatory development research activity is conducted by examining alternative regulatory approaches and continuing to analyze regulatory requirements so that research programs are responsive to program and regional office needs. The technology transfer research activity supports the development and delivery of technical information tools to regions, States, counties, municipalities, Indian tribes, and media program offices. Special efforts will also be made to improve inhouse scientific capabilities by replacing aging scientific equipment.

Air quality: Research efforts are scheduled to increase to $95 million in 1991. These activities will support an expansion of the Regional Oxidant Model (ROM) with an emphasis on understanding biogenic emissions and their effect on ozone concentrations. The ROM will be extended beyond the Northeast to develop effective strategies for an ozone air quality standard. Acid aerosol research will evaluate the need for an acid aerosol regulation. Research will be conducted on remote sensing as an alternative to ground-based or airborne monitoring. Research will also be conducted on alternative fuels, exposure to building materials, consumer-applied pesticides, and screening procedures and measurements for "sick building syndrome".

Superfund and LUST trust fund: Research activities in these programs are proposed to increase 11 percent in 1991 to $72 million. The Superfund research and development program provides a core of scientific and technical information to support efforts under the Superfund legislation. The research program will continue to support EPA, States, and industry in resolving technical problems with removal and remedial actions at Superfund sites. Emphasis in 1991 will be on technical support as recommended by EPA's Superfund Management Review. This includes providing technical advice to remedial project managers, conducting and evaluating treatability studies, and providing onsite technical expertise. The Leaking Underground Storage Tanks (LUST) Program provides technical assistance to the EPA's Office of Underground Storage Tanks and will focus on ensuring the selection of the best available site assessment and cleanup procedures by responsible authorities.

Hazardous waste: This program will focus on developing scientific and technical information required to accurately support hazardous waste regulations. Research will be conducted on waste characterization and identification, land disposal, incineration, quality assurance, hazardous releases, and alternative disposal technologies. Emphasis in 1991 will be on developing new methods to manage municipal solid waste.

Water quality: This program provides the scientific and technical data to States and EPA's Office of Water in implementing the Clean Water Act, the Marine Protection, Research and Sanctuaries Act, and the Plastics Pollution Research and Control Act. Increased research will focus on sediment quality

FEDERAL R&D FUNDING BY BUDGET FUNCTION:
NSF90-311... NATIONAL SCIENCE FOUNDATION
APRIL 1990

NS 1.18/4:989-91

2 OF 2
24X
SUPTDOCS/GPO
P.0088-0125

related to water quality criteria, wetlands research in support of "no net loss" policies, and oil spill research to improve clean-up technologies.

Toxic substances: R&D efforts will continue to provide scientific tools and supporting information needed to implement the pre-manufacture notification system for new chemicals under the Toxic Substances Control Act (TSCA), the Asbestos Hazard Emergency Response Act (AHERA), and the Emergency Planning and Community Right to Know Act. New research efforts will support lead pollution prevention efforts and increased research will be undertaken on the effect of genetically engineered micro-organisms on the environment and on health.

Drinking water: Research activities within this program will focus on drinking water contaminants and the protection of groundwater resources. Research will continue to provide data on disinfectants, used in place of chlorine and their reactive byproducts. Research will also be conducted on groundwater contaminants, with an emphasis on developing detection methods, understanding and predicting their behavior, and evaluating the availability and cost effectiveness of clean-up alternatives.

Pesticides: Research funding is proposed to increase in 1991. This research program will assess pesticides interaction with human activities and the environment to ensure that pesticide use does not pose unreasonable adverse risk to public health and the environment. Primary focus will be on pollution prevention research, the expansion of toxicokinetics and effects analysis, and data collection efforts for ecological risk assessments. Biotechnology research will examine the effects of genetically engineered micro-organisms on health and on the environment.

Radiation: This program provides Federal, regional, State, and local officials with scientifically credible data, methods, and assessments required to determine and control public exposure to radioactive materials in the environment. Emphasis in 1991 will be on demonstrations of techniques for preventing or mitigating exposure to indoor radon gas in new and existing housing structures, homes under construction, and school buildings. Monitoring and quality assurance support will be provided to laboratories that measure radionuclide emissions. Under an interagency agreement with DOE, EPA will conduct radiological monitoring and surveillance services around nuclear test sites. The funding represents salaries and expenses in connection with EPA personnel assigned to providing monitoring and quality assurance support to the Nevada test site.

Conservation and land management

R&D funding for conservation and land management is proposed at $158 million in 1991 which is $5 million above the 1990 level. The Forest Service, accounting for 94 percent of the funding for this subfunction, is scheduled for a 1-percent increase. The forest and environmental research program reflects the largest proposed increase in support, $3 million, for a total of $37 million. All other R&D programs within the Forest Service will receive very small increases or decrease slightly in funding.

Forest Service R&D programs provide land managers and owners with scientific information on the management of timber, forage, wildlife, recreation, and watershed to provide for the continued use and productivity of the Nation's forests and related rangelands. Current areas of research include genetics, timber management, watershed management, wildlife, fish habitats, range management, recreation, protection of forest resources from fire and forest pests, forest utilization and harvesting, economics of forest resource production, and forest inventory and analysis.

R&D budget authority for conservation and land management
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$144	$153	$158	3.1%
Forest Service (USDA)	138	147	149	1.1
Forest and environmental research	31	34	37	7.3
Forest protection	34	35	36	2.0
Timber management	27	30	30	0.7
Resource analysis	26	27	26	-3.8
Forest products and harvesting	21	22	21	-3.7
Research challenge cost share	1	-	-	*
Department of the Interior	6	6	9	57.1
Bureau of Land Management	3	3	5	86.2
Minerals Management Service	2	2	3	35.0
Office of Surface Mining and Reclamation	1	1	1	0.0
Office of the Secretary	(a)	1	1	75.0

* Scheduled for termination in FY 1990.
(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Recreational resources

Support for recreational resources R&D programs, all within the Department of the Interior, will increase by $1 million to $92 million in 1991. The Fish and Wildlife Service funds three-quarters of total Federal R&D support in recreational resources. Funding for these R&D programs are expected to decrease 3 percent to $69 million. The Fish and Wildlife Service will continue to support research and development in the following areas: contaminants and their effect on fish and wildlife species; preserving and managing migratory birds and other wildlife; protecting and perpetuating freshwater, anadromous, estuarine fish; and on the status and distribution of endangered and threatened species. Decreases in funding are proposed for wildlife research, fisheries research, and contaminants research. The National Park Service will expand its R&D activities by 17 percent to $23 million in 1991. Research programs will focus on protecting and preserving the natural and cultural resources of the National Parks.

R&D budget authority for recreational resources
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$80	$91	$92	1.5%
Fish and Wildlife Service (Interior)	61	71	69	-2.8
Fish and wildlife research and operations	48	57	51	-9.5
Wildlife	15	18	15	-14.3
Fisheries	15	16	14	-13.0
Contaminants	12	13	12	-6.1
Endangered species	5	6	6	0.0
Research center maintenance	1	4	4	2.6
Technical development	7	8	10	35.1
Cooperative research units	6	7	7	10.8
National Park Service (Interior)	19	20	23	16.9

SOURCE: National Science Foundation, SRS

Water resources

The 1991 R&D budget request for water resources is $58 million--an increase of $18 million, or 47 percent--over the 1990 level. This growth is primarily attributable to the R&D programs of the Army Corps of Engineers (Corps) within DOD and the Bureau of Reclamation within the Department of the Interior. R&D activities of the Corps are expected to rise 40 percent to $49 million. Additional funding is proposed for the R&D construction, operations, and maintenance program, and the magnetic levitation research program (magnetic levitation research is also being proposed by the U.S. Department of Transportation under the transportation function). New funding is proposed for studying the impact of climate change. Efforts will also focus on dam safety, protection of our ocean's shores, navigation, flood control, ice and its effects on navigation and flooding, environmental impacts in wetlands, and effects of contaminant mobility and toxic substances in dredged materials. The Bureau of Reclamation's R&D program will increase 100 percent to $9 million.

R&D budget authority for water resources
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$41	$39	$58	46.7%
Army Corps of Engineers (DOD)	37	35	49	39.9
R&D construction operations and maintenance	17	13	21	62.7
Coastal engineering	6	5	6	9.6
Construction productivity advancement research	3	4	5	28.2
Flood control and navigation	5	4	5	14.0
Magnetic levitation research	-	1	4	250.0
Materials research	3	3	3	12.0
Water resources planning studies	1	2	2	0.0
Environmental quality	2	2	2	5.6
Surveying and remote sensing	1	1	2	70.0
Climate change impact program	-	-	1	**
Coastal engineering research board	(a)	(a)	(a)	0.0
Bureau of Reclamation (Interior)	4	4	9	100.0

** Proposed new initiative.
(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Other natural resources

Other natural resources represents about 47 percent of the funding for the function and it is comprised of the R&D programs of three agencies: the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and the U.S. Bureau of Mines. These programs are scheduled for an $18 million, or 3 percent, decrease in 1991 to $668 million.

R&D programs of the U.S. Geological Survey within the Department of the Interior are proposed to increase 2 percent to $305 million. These R&D programs provide scientific data and information on the Nation's water, land, and mineral resources. All major programs, except the geological mineral resource surveys and mapping program, are expected to have increases in their R&D funding in 1991. Funding for 1991 emphasizes global climate change and water quality research, and the continued development of advanced cartographic systems. National water resources and research and information systems, the only R&D program within water resources investigations, will increase 10 percent to $93 million.

R&D budget authority for the National Oceanic and Atmospheric Administration within the Department of Commerce is scheduled to remain constant at approximately $284 million. The proposed 1991 budget includes the proposed elimination of the Fishery products promotion and development program and significant decreases in funding for some programs of the National Marine Fisheries Service. These decreases reflect the Administration's policy of reduced support in areas deemed more appropriately the responsibility of State and local governments or private industry. The National Weather Service and the National Oceans Service are proposed to increase their R&D funding. Increases in R&D funding are requested to improve monitoring, prediction, and understanding of the environmental degradation of the coastal areas, for marine sanctuaries and for ocean services.

R&D programs of the U.S. Bureau of Mines within the Department of the Interior are expected to decrease 23 percent to $78 million in 1991. The Bureau of Mines will continue to support research in all aspects related to the health and safety of miners, and to develop information on basic scientific and engineering principles of mineral processing that will enhance the mineral industry's efforts to investigate new or alternative production techniques. Research is also conducted on mitigating or eliminating adverse environmental impact associated with mining and mineral processing.

R&D budget authority for other natural resources

[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$659	$686	$668	-2.7%
U.S. Geologic Survey (Interior)	280	300	305	1.6
Geologic and mineral resource surveys and mapping	178	193	185	-4.3
Geologic hazards surveys	48	60	49	-18.7
Mineral resource surveys	48	47	46	-0.9
Geologic framework and processes	28	33	37	12.5
Offshore geologic surveys	27	27	27	1.5
Energy geologic surveys	27	27	26	-4.8
Water resources investigations	82	84	93	10.3
Federal program	49	52	67	30.3
Federal/State cooperative program	23	23	21	-7.0
State programs	10	10	5	-53.5
National mapping, geography and survey	20	23	27	19.7
National Oceanic and Atmospheric Administration (Commerce)	282	285	284	-0.2
Operations, research and facilities	274	281	284	1.1
Oceanic and atmospheric research	94	100	104	3.7
National Marine Fisheries Services	94	90	72	-19.7
National Weather Service	30	32	38	18.3
National Oceans Service	17	22	34	52.5
National Environmental Satellite Data Information Service	8	8	8	0.0
Program support	32	29	30	1.0
Fishery products promotion and development	8	5	-	*
Bureau of Mines (Interior)	96	100	78	-22.6

---

* Proposed for termination.

SOURCE: National Science Foundation, SRS

TRANSPORTATION

R&D funding for transportation (function 400) is comprised of four separate subfunctions: air, ground, water, and other R&D activities. The Department of Transportation (DOT) and the National Aeronautics and Space Administration account for all of the R&D support in this function. The R&D programs of the Department of Transportation provide information on new technologies for the Department's operational and regulatory programs. The transportation R&D programs of NASA are primarily engaged in aeronautical and transatmospheric research and development.

The proposed R&D budget authority for transportation is $1.3 billion in 1991. This increase of $198 million, or 17 percent, represents sizable gains in air, water, and ground transportation research and development. Major program increases in the 1991 budget request are highlighted below.

- A total of $1.1 billion is proposed for air transportation programs, 13 percent more than in 1990.
    - The aeronautical research and technology programs of NASA will receive an additional $82 million.
    - The transatmospheric research and technology programs of NASA will increase by $30 million.
    - The R&D programs of DOT's Federal Aviation Administration will grow by $20 million.
- The ground transportation programs are proposed at $184 million in 1991, 52 percent more than in 1990.
    - R&D programs of the Federal Highway Administration are scheduled to rise by $37 million.
    - The National Highway Traffic Safety Administration (NHTSA) R&D programs will grow by $20 million.
    - The Federal Railroad Administration will increase R&D funding by 63 percent to $16 million.
- A 12 percent increase, or an additional $2 million, is proposed for water transportation R&D by the U.S. Coast Guard in 1991.

R&D budget authority for transportation
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$1,064	$1,144	$1,342	17.3%
Air transportation	922	994	1,126	13.3
National Aeronautics and Space Administration	750	809	920	13.8
Aeronautical research and technology	707	771	852	10.6
Transatmospheric research and technology	43	38	68	79.0
Federal Aviation Administration (DOT)	172	185	205	10.9
Ground transportation (DOT)	115	121	184	52.2
Federal Highway Administration	74	82	119	44.8
National Highway Traffic Safety Administration	30	28	48	73.3
Federal Railroad Administration	9	10	16	63.2
Urban Mass Transportation Administration	2	2	2	0.0
Water transportation (DOT)	19	21	23	12.2
U.S. Coast Guard	19	21	23	12.2
Other transportation (DOT)	8	9	10	2.2
Office of the Secretary	6	7	7	7.5
Research and Special Programs Administration	2	3	2	-11.5

SOURCE: National Science Foundation, SRS

Air transportation

In the 1991 budget, R&D funding for air transportation is proposed to rise to $1.1 billion. This increase of 13 percent is largely attributable to planned growth in funding for the transatmospheric research and technology programs.

Within the overall increase in NASA's aeronautical research and technology programs, research and technology base programs will decrease by $8 million to $281 million in 1991. A major goal of these programs is to strengthen U.S. leadership in civil and military aviation. The applied aerodynamics program emphasizes research on subsonic/transonic drag reduction and on new non-conventional platforms having improved maneuverability and performance. Propulsion and power will focus R&D efforts on improved understanding of the physical phenomena at the component and subsystem level leading to future high payoff improvements in capability and efficiency. R&D support will also continue for controls and guidance research to provide a technology base which supports aircraft designs capable of safer and more efficient operation, and having greatly expanded flight envelopes.

The systems technology programs are proposed to rise by $64 million to $155 million. The numerical aerodynamic simulation program, the largest component of the systems technology programs, is expected to rise in 1991. The program's objective is to develop a preeminent capability for numerical simulation of aerodynamic flows. The high speed research program will build on previous efforts to resolve critical environmental issues including ozone depletion, airport noise, and sonic boom.

In 1991, the transatmospheric research and technology program will receive an increase of $30 million, or 79 percent more than 1990 funding levels, for a total of $68 million. The objective of this program, supported by NASA in conjunction with the Air Force's advanced technology development program, is to develop the technology base for a national aerospace plane (The Department of Air Force's funding for the national aerospace plane is proposed at $158 million in 1991 and is discussed in the national defense chapter of this report).

The R&D programs of the Federal Aviation Administration are proposed to grow to $205 million in 1991. FAA is presently developing a revised R&D program that provides a balance between near-term development activities and long term research activities. FAA's R&D program focuses its major support on areas such as safety, security, capacity, and efficiency. All programs are proposed for additional funding, except for the aviation weather and aviation medicine programs. The air traffic control program in 1991 establishes some new and innovative initiatives, such as a National Simulation Laboratory, which will investigate the symbiosis between the National Airspace System Plan and the technology for the air traffic control system of the twenty-first century. R&D efforts in the aircraft safety program will focus on the development of an Explosives Detection Laboratory and expanding the application of DOD and NASA research on metal fatigue, corrosion, and properties of composite materials into the civilian sector to better detect defects and prevent the deterioration of aging aircraft.

R&D budget authority for air transportation
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$922	$994	$1,126	13.3%
National Aeronautics and Space Administration	750	809	920	13.8
Aeronautical research and technology	707	771	852	10.6
Research and technology base	259	289	281	-2.8
Systems technology programs	74	91	155	70.3
Research and program management	374	390	416	6.6
Transatmospheric research and technology	43	38	68	79.0
Federal Aviation Administration (DOT)	172	185	205	10.9
Air traffic control	89	93	104	11.6
Aircraft safety	24	35	47	33.4
Advanced computer	23	18	19	7.3
Operations development	12	15	15	3.4
Aviation weather	13	13	8	-41.2
Aviation medicine	6	7	7	0.0
Navigation	3	3	3	30.8
Environment	2	2	2	20.0

SOURCE: National Science Foundation, SRS

Ground transportation

R&D support for ground transportation is proposed to increase by $63 million, or 52 percent, to $184 million in 1991. This growth is attributable in part to the R&D programs of the Federal Highway Administration with emphasis on the planning, design, maintenance, and construction of the nation's highway system. Funding increases are also proposed for two other agencies with R&D activities in ground transportation: the National Highway Traffic Safety Administration and the Federal Railroad Administration. Research within these agencies is conducted on motor vehicle, highway, and railroad safety. In 1991 the Federal Highway Administration will increase funding for the Intelligent Vehicle/Highway Systems (IVHS) program. IVHS will use electronics and computer systems to improve traffic controls and make efficient use of the road systems. The 1991 budget also includes $6 million for the Federal Railroad Administration to assess the potential for a large scale domestic application of "magnetically levitated trains"(additional research funding is provided by the Army Corps of Engineers and reported under the natural resources and environment function). Funding for the R&D programs of the Urban Mass Transportation Administration is expected to remain stable.

Water transportation

Water transportation R&D is comprised of programs of the U.S. Coast Guard. Funding for these activities is expected to increase 12 percent, or $2 million, to $23 million in 1991. The Coast Guard conducts research on improving search and rescue missions, protecting the marine environment, marine safety, aids to navigation, and on the enforcement of laws and treaties. Water transportation R&D programs within the Maritime Administration were phased out, effective in the 1988 budget.

Other transportation

This category includes R&D programs that are not classified under air, ground, or water transportation. The Office of the Secretary of Transportation and the Research and Special Programs Administration (RSPA) account for all of the activities within this subfunction. The Office of the Secretary is proposed for a slight increase in funding for R&D and will focus efforts on planning, analysis, and information development in the following areas: regulatory modernization; energy conservation; environmental and safety impacts of transportation policy; university research and internships in the field of transportation; and research in support of licensing and promoting expendable launch vehicles. RSPA R&D activities will continue efforts in areas such as hazardous materials, pipeline safety, and emergency transportation.

AGRICULTURE

The Department of Agriculture (USDA), which supports all programs in this function (function 350), funds research and development aimed at improving the productivity of U.S. agriculture. The USDA has organized its 1991 budget around several cross-cutting initiatives that provide growth for many R&D programs and a 6-percent increase in R&D funds overall. Initiatives that include R&D components include Food Safety, the National Research Initiative, Water Quality, Global Change, and Strengthening 1890 Land-Grant Institutions.

Highlighted below are the most significant changes for R&D programs appearing in USDA's 1991 budget.

- Research and development funding at the Agricultural Research Service (ARS) is proposed to receive a $41-million increase over 1990 levels to augment programs pertaining to four of USDA's proposed initiatives:
  - As part of the National Research Initiative, increased funding is proposed for research on plant sciences to begin mapping the genomes of important crop plants.
  - Research on commodity conversion and delivery will be enhanced as part of the Food Safety Initiative to improve testing, detection, and control of food contaminants.
  - Increased funding is requested for research on soil and water conservation as a part of both the Water Quality and the Global Change initiatives to minimize water quality degradation and to improve understanding of the impacts of agricultural practices on the environment.
- The Cooperative State Research Service (CSRS) is proposed to receive a net increase of almost $11 million over 1990 levels as a result of the expansion of competitive research grants and concomitant reductions in other programs:
  - Funding for competitive research grants is proposed to increase to restructure and augment the grants program under the National Research Initiative; funding for special research grants is reduced significantly.
  - Funding to 1890 land-grant institutions is proposed at an increased level to strengthen the research and teaching capacity of these institutions.

R&D budget authority for agriculture

[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent Change 1990-1991
Total	$906	$949	$1,009	6.3%
Agricultural Research Service	519	542	583	7.5
Research on plant sciences	205	209	221	5.6
Research on commodity conversion and delivery	103	106	117	10.2
Research on animal sciences	91	96	100	3.8
Research on soil & water conservation	63	71	86	20.4
Human nutrition research	44	46	46	0.0
Integration of agricultural systems	13	12	12	0.9
Contingency funds	1	1	1	0.0
Cooperative State Research Service	308	325	335	3.2
Payments under the Hatch Act	156	155	159	2.2
Competitive research grants 1/	40	43	-	
National Research Initiative	-	-	100	**
Plant systems	-	-	50	**
Animal systems	-	-	30	**
Natural resources and environment	-	-	15	**
Nutrition, food quality and health	-	-	5	**
Special research grants	56	69	31	-55.1
Payments to 1890 colleges and Tuskegee Institute	24	25	26	4.8
Cooperative forestry research	18	17	13	-24.9
Administration	6	11	7	-36.8
Animal health and disease research	6	5	-	*
Economic Research Service	49	51	56	11.0
Animal & Plant Health Inspection Service	11	13	13	5.6
Human Nutrition Information Service	9	9	12	35.2
National Agricultural Statistics Service	3	3	3	3.1
Agricultural Cooperative Service	3	3	3	3.6
Agricultural Marketing Service	2	2	2	6.2
Office of Transportation	1	1	1	0.0
Federal Grain Inspection Service	(a)	(a)	(a)	0.0
Office of International Coop/Development	1	1	(a)	-100.0

1/ Proposed 1991 funding is included under the National Research Initiative.

* Proposed for elimination

** Proposed new initiative

(a) less than $500,000

SOURCE: National Science Foundation, SRS

Agricultural Research Service

The ARS is the primary research agency of the USDA, conducting most of its research at Federal laboratories. Its research programs are directed toward improving the safety and the economical supply of agricultural products. Areas receiving special attention in the 1991 request include soil and water quality, plant productivity, food safety and quality, and production efficiency of livestock and poultry.

The ARS is proposed to receive $583 million in R&D funds in 1991, an increase of $41 million over 1990 levels. This growth provides additional funding for new programs and the expansion of existing ones as part of the USDA's major 1991 initiatives.

Research on plant sciences: This program conducts research to improve plant productivity through the enhancement of plant varieties and the improvement of crop production practices. The proposed increase supports the expansion of germplasm preservation and evaluation programs and of research to develop agents to control the growth of coca, the source of cocaine. The increase also provides funding for a new program, jointly funded through the National Research Initiative, to begin mapping the genomes of important crop plants.

Research on commodity conversion and delivery: Research under this program focuses on the development of new and improved foods, feeds, and other commodities, and the improvement of processing, transportation, storage, wholesaling, and retailing of agricultural products. In conjunction with the USDA's Food Safety Initiative, an increase is proposed to expand research to improve assessment and testing techniques for bacterial contamination and drug and pesticide residues in food products.

Research on animal science: This program supports research to develop diagnostic methods for regulatory programs, to improve animal germplasm preservation methods, and to enhance disease resistance for livestock and poultry. The increase requested for 1991 augments efforts in all of these areas.

Research on soil and water conservation: This program conducts research that serves as a basis for technical advances in the management and conservation of soil and water resources. The proposed growth supports an expansion of research under the Water Quality Initiative to develop ways to minimize the adverse effects that agricultural management practices have on water quality. Increased funding is also provided to conduct research to improve our understanding of the impacts these practices have on the global environment as part of the Global Change Initiative.

Human nutrition research: Research in this program is aimed at determining human nutritional requirements and the nutritive value of foods. Funding for this program will remain at 1990 levels.

Integration of agricultural systems: This program develops integrated systems for production, processing, and marketing agricultural products. The 1991 request proposes funding for this program to remain at the 1990 level.

Cooperative State Research Service

The CSRS administers federal funds through formula and competitive grants for research at the state agricultural experiment stations of land-grant universities and other eligible institutions. The agency also participates in a nationwide agricultural system of research planning and coordination. A total of $335 million is proposed for CSRS R&D programs in 1991, a net increase of $10 million over 1990.

Payments under the Hatch Act: This program provides formula grants to state agricultural experiment stations of land-grant universities and other eligible institutions. The 1991 request proposes increased funding to partially offset the rising cost of this program.

The National Research Initiative on Agriculture, Food, and the Environment: One of the initiatives of the USDA's 1991 budget, this program is proposed to receive $100 million in 1991. This new initiative, funded as a competitive research grants program, will focus on four broad areas: Basic plant and animal systems, global change, water quality, and human nutrition. Part of the funding provided in previous years for animal health and disease research and cooperative forestry grants is incorporated into this program.

Payments to 1890 colleges and Tuskegee Institute: This program provides formula grants to the historically black colleges. The 1991 budget requests additional funding to partially offset the increasing costs of this program.

Special research grants: This program provides grants to eligible cooperative institutions to meet national needs or to address critical areas needing a short-term infusion of funds. The significantly reduced level of funding in 1991 is due to the reduction to seven in the number of grant programs identified as areas of national priority. Support for these seven special grants, which focus on water quality, global change, animal drugs, and pesticide clearance, management, and impact assessment, will be provided at increased levels.

Cooperative forestry research: Funding for this program is allocated by formula to state agricultural experiment stations and universities having a forestry school or offering graduate training in related sciences. The reduction in funding proposed for this program in 1991 is partially offset by funds for forestry research provided under the National Research Initiative.

Administration: Federal administration in 1991, funded through a combination of set-asides from formula and grant programs and a direct appropriation, will continue to support a coordinating and review staff to maintain cooperation between state and Federal research partners. The 1991 budget decrease represents the proposed elimination of all directly appropriated administration support, but includes augmented funding for capacity building grants to historically black institutions to strengthen their research and teaching capacity.

Economic Research Service

The Economic Research Service (ERS) performs agricultural economic and other social science research, forecasting, policy analysis, and develops quantitative indicators pertaining to agriculture, food, natural resources, and rural America.

The 1991 budget provides $56 million for ERS in 1991, about $6 million more than in 1990. The proposed increase provides funding for water quality data collection and analysis as part of the government-wide Water Quality Initiative and funding for food safety analysis under the Food Safety Initiative.

Other departmental programs

The Human Nutrition Information Service is proposed to receive an increase of $3 million. Funding for other agricultural programs are scheduled to remain at 1990 levels.

EDUCATION, TRAINING, EMPLOYMENT, AND SOCIAL SERVICES

R&D activities within education, training, employment, and social services (function 500) are conducted by the Department of Education, the Office of Human Development Services of the Department of Health and Human Services, the Smithsonian Institution, and the Department of Labor.

The proposed R&D budget authority for this function is $410 million, a 5-percent increase from the $390 million level in 1990. Highlights of the major R&D program emphases in 1991 follow.

- An increase of $16 million in research and general education aids is proposed with an increased emphasis on programs of the Smithsonian Institution.

- R&D support for social services will increase by $3 million to $178 million with the major increase directed to research on programs for children, youth and families.

- A $3 million increase in support for other labor services results from modest growth in the R&D programs of the Bureau of Labor Statistics, the Pension Welfare Benefits Program, and departmental management.

- Increases noted above will be offset by reduced R&D support for training and employment which will decrease by nearly $2 million.

R&D budget authority for education, training, employment, and social services

[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$348	$390	$410	5.1%
Research and general education aids	173	190	206	8.5
Department of Education	91	102	106	4.1
Smithsonian Institution	82	88	100	13.6
Social services	154	175	178	1.8
Human Development Services (HHS)	99	117	122	3.9
Programs for children, youth and families	77	92	98	6.4
Programs for the aging	15	18	17	-7.1
Social services research	4	4	4	0.0
Programs for the developmentally disabled	3	3	3	0.0
Programs for native americans	1	1	1	0.0
Rehabilitation services and handicapped research (Education)	55	58	57	-2.6
Training and employment	6	8	6	-20.8
Employment and Training Adm. (Labor)	6	8	6	-20.8
Other labor services (Labor)	15	17	19	12.9
Departmental management programs 1/	6	8	9	17.9
Bureau of Labor Statistics	7	7	8	4.1
Pension Welfare Benefits Program	1	2	2	40.0
Bureau of Labor-Management Relations and Cooperative Programs	(a)	(a)	(a)	0.0
Employment Standards Administration	(a)	(a)	(a)	-18.9

1/ Includes the Office of the Assistant Secretary for Policy, the International Labor Affairs Bureau, and the Women's Bureau.

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Research and general education aids

The programs under this category account for one-half of the 1991 R&D funding for the education, training, employment, and social services function. R&D is expected to increase nearly 9 percent to $206 million with nearly three-fourths of the increase scheduled for R&D support for the Smithsonian Institution.

R&D budget authority for research and general education aids
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$173	$190	$206	8.5%
Department of Education	91	102	106	4.1
Research, statistics, and improvement of practice	28	33	39	19.6
Education for the handicapped	27	28	28	0.0
Vocational and adult education	15	16	9	-44.5
Special institutions	8	8	9	8.7
Chapter 1 evaluation and technical assistance	5	5	8	55.6
Fund for innovation in education	2	2	4	75.0
Bilingual education	3	3	3	0.0
International education and foreign language studies	2	2	2	0.0
Drug-free schools and communities: national programs	1	2	2	-15.0
Jacob K. Javits gifted and talented student education	-	2	2	0.0
Chapter 1 Even Start	(a)	(a)	1	250.0
Fund for the improvement of postsecondary education	(a)	(a)	1	25.0
Library research and demonstrations	(a)	(a)	(a)	0.0
Science and mathematics programs of national significance	1	1	-	*
Smithsonian Institution	82	88	100	13.6

* Scheduled for termination.
(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

The Department of Education accounts for just over one-half of the funding within this subfunction. These programs are scheduled to increase by $4 million to $106 million. The largest amount of proposed funding is $39 million (a $6 million increase) for the research, statistics and improvement of practice account (formerly called education and research statistics). This support would be used for new R&D efforts related to the achievement of disadvantaged youngsters, parent and family involvement, illiteracy, parent choice, school restructuring, accountability, and teacher performance.

Support for education for the handicapped programs is scheduled to remain level in 1991 and provide support for various R&D activities related to improving early intervention and educational services for handicapped children.

An independent annual evaluation of the chapter 1 Even Start program is proposed at $1 million in 1991. Even Start, a program instituted by the Elementary and Secondary Education Act of 1965, provides educational services to children under 7 years of age and basic education to their parents.

Begun in 1990, the Jacob K. Javits gifted and talented student education program is proposed for a 1991 funding level of nearly $2 million. This program conducts research on methods and techniques for identifying and teaching gifted and talented students, and develops program evaluations and surveys of gifted and talented programs.

Other proposed changes in the budget include the following: R&D programs for special institutions are expected to increase 9 percent to $9 million in 1991; a $3 million increase is proposed in 1991 for chapter 1 evaluation and technical assistance; and the fund for innovation in education program is scheduled to increase by nearly $2 million.

The Smithsonian Institution is proposed to grow 14 percent to $100 million in 1991. A major portion of the Institution's request for additional funding for research will enable the Smithsonian Astrophysical Observatory to continue to develop new, and reconfigure existing, instrumentation. The Institution will build upon its current programs to undertake important research initiatives in the field of global change.

Social services

R&D activities classified under social services are comprised of programs within the Office of Human Development Services (HHS) and the Department of Education. The R&D programs of the Office of Human Development Services are proposed to increase by 4 percent to $122 million in 1991. The increase will support R&D activities on issues associated with crack cocaine use and HIV infected children. Research efforts will also focus on runaway and homeless youth, child abuse, youth drug prevention, child welfare, adoption opportunities, and aging and developmental disabilities.

The rehabilitation services and handicapped research program of the Department of Education is expected to decrease by 3 percent to $57 million. Research under this program will continue to identify the causes and consequences of disability and to discover new ways of maximizing the personal autonomy, self sufficiency, development, health, and physical and emotional status of disabled persons.

Training and employment

In the 1991 budget, R&D programs conducted by the Employment and Training Administration will decrease to $6 million, nearly $2 million less than funding levels for 1990. R&D funding provides support for studies directed to immediate and long-range labor market problems. Major objectives include studies on improving the training and employment system, improving forecasting techniques, and utilizing projections of labor demand and supply and skill requirements to develop training programs corresponding to the needs of the labor force.

Other labor services

Programs classified under other labor services include all labor-related R&D activities, other than employment and training. R&D support for other labor services is proposed to increase 13 percent to $19 million. The largest R&D program is labeled as departmental management but consists of R&D activities supported by three separate offices. The Office of the Assistant Secretary for Policy (OASP) will emphasize research on the efficient use of scarce enforcement resources, immigration and its impact on the workforce, regulatory reform, the efficiency of human capital markets, pension regulation policy, and youth unemployment. As authorized through the Anti-Drug Abuse Act of 1988, OASP will monitor and continue to support activities designed to constructively address the problem of workplace substance abuse. The International Labor Affairs Bureau will conduct research on the impact of changes in U.S. international economic policies on the welfare of U.S. workers. The Women's Bureau will emphasize research support on issues related to the dominance of women in the service economy, the international economy in relation to job flight, and other issues affecting the welfare of wage-earning women.

Within other labor services, R&D programs supported by the Bureau of Labor Statistics (BLS) will increase to $8 million in 1991. Resources are primarily assigned toward research designed to maintain the quality, relevance, and timeliness of the Bureau's statistical and analytical output. Research is also directed towards analyses on the behavior of employment, prices, wages and productivity in the economy.

INTERNATIONAL AFFAIRS

All R&D activity within the international affairs function (function 150) is conducted by the Agency for International Development (AID). The budget authority request for AID's R&D programs in 1991 is $219 million, an increase of $7 million, or 3 percent, above 1990 funding. R&D activities in 1991 comprise about 1 percent of total Federal budget authority for this function.

In general, R&D activities within this function focus on solving specific problems associated with basic human needs and on social and economic research aimed at understanding the barriers to development. R&D priorities reflect the important development problems faced by the Third World: food and agriculture, health and population, education and human resources, energy and natural resources, and small enterprise development.

R&D budget authority for international affairs
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$279	$212	$219	3.3%
Agency for International Development				
Science & technology	118	102	89	-12.5
Asia, Near East and Europe	42	34	33	-1.8
Africa	36	36	29	-19.7
Latin America and Caribbean	15	8	10	30.4
Science advisor	10	9	10	15.1
Private enterprise	1	1	1	9.1
Program policy coordination	58	23	46	100.9

SOURCE: National Science Foundation, SRS

VETERANS BENEFITS AND SERVICES

All R&D activity within the veterans benefits and services function (function 700) is funded through the Department of Veterans Affairs. The Department conducts and administers a program of medical, rehabilitation, and health services research designed to improve the quality and effectiveness of health care for the veteran. In 1991, R&D programs account for less than 1 percent of total Federal budget authority for this function.

In 1991, the R&D budget request for this function is $201 million, a decrease of $14 million, or 7 percent, below 1990. This is primarily attributable to the reduction in funding for investigator-initiated studies.

Highlights of the major programs emphasized in the 1991 budget follow.

- Investigator-initiated studies, which comprise over four-fifths of medical and prosthetic research, are proposed at $135 million in 1991, a decrease of $15 million from 1990. Current emphasis within the medical research program is given to Agent Orange, aging, alcoholism, post-traumatic stress, health problems of former prisoners of war, and Acquired Immune Deficiency Syndrome (AIDS).

- The rehabilitation research and the health services research programs are each expected to be increased by $1 million above 1990 levels. Rehabilitation research is directed toward providing health care services for aging and disabled veterans including devices that minimize their disability and enhance the quality of their lives. The goal of health systems research and development is to support the search for the most cost-effective approaches to delivering quality health care to veterans.

- Funding for each of the remaining R&D programs is proposed to decrease slightly or remain at 1990 levels, except for the Centers for Disease Control's epidemiology study, which was completed in 1989.

R&D budget authority for veterans benefits and services

[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$212	$215	$201	-6.7%
Department of Veterans Affairs				
Medical and prosthetic research	182	182	166	-8.9
Investigator-initiated studies	142	149	135	-9.7
Career development	17	18	17	-7.6
Cooperative studies	15	10	9	-4.1
Special research initiatives	4	3	3	0.0
Agent orange studies	1	1	1	10.0
Epidemiology study (CDC)1/	2	-	-	-
Rehabilitation research	19	22	23	4.6
Health services research	9	9	10	9.6
Medical administration and miscellaneous operating expenses	2	2	2	0.0

1/ Study was managed by the Centers for Disease Control (CDC) in Atlanta, Georgia.

SOURCE: National Science Foundation, SRS

COMMERCE AND HOUSING CREDIT

R&D in the commerce and housing credit function (function 370) is supported by the National Institute of Standards and Technology (NIST), the National Telecommunications and Information Administration, and the Bureau of the Census, all within the Department of Commerce. Commerce and housing credit R&D funding is proposed to increase by nearly $20 million to a level of $158 million in 1991. Most funding for this function is for the R&D programs of NIST. R&D programs within NIST focus on the development and maintenance of a system of measurements necessary for support of the Nation's industrial and scientific efforts.

The 1991 R&D budget request for NIST will support increased funding for the following programs: atomic scale electronics; chemical measurements and standards; intelligent processing of materials, concerning fundamental measurement theory and automation that industry requires in order to process advanced materials efficiently; high performance composites; lightwave measurement technology; advanced semiconductors that will enable development of new measurement methods to support research, development, manufacturing and procurement tests to facilitate marketability of U.S. products; bioprocess engineering; high temperature superconductors; intelligent machines; computer security that will enable establishment of an emergency response capability; and integrated services digital network.

R&D budget authority for commerce and housing credit
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$128	$139	$158	14.1%
Department of Commerce				
National Institute of Standards and Technology	116	126	145	15.3
Engineering measurements and standards	37	39	46	18.3
Measurement research and standards	38	39	45	16.1
Materials science and engineering	19	19	21	11.7
Computer sciences and technology	8	8	12	36.9
Industrial technology services	3	10	10	4.1
Research support activities	12	12	12	2.6
National Telecommunications and Information Administration	8	8	8	3.8
Bureau of the Census	5	5	5	0.0

SOURCE: National Science Foundation, SRS

COMMUNITY AND REGIONAL DEVELOPMENT

R&D funding for community and regional development programs (function 450) is proposed at $100 million in 1991, a 29 percent increase from 1990 levels. R&D programs comprise about 1 percent of total Federal budget authority for this function in 1991. Slightly over one-half of all funding for this function is for the Tennessee Valley Authority (TVA). Most of TVA's funding is directed toward the development of technologies to assist in keeping electric rates at the lowest level possible; to research, develop, and transfer technology of new fertilizer products and fertilizer use that will increase the production of food and fiber in an economical and environmentally safe manner; to develop innovative new technologies and techniques to protect and enhance the environment; and to assist in the regional economy to improve the quality of life for the people of the Tennessee Valley and the Nation.

Nearly all of the increase in proposed R&D support for the Department of Housing and Urban Development (HUD) in 1991 results from funds transferred from other accounts within HUD to support program evaluation and monitoring activities. This expanded effort will focus on the cost-effectiveness, equity, and impact of the agency's programs. Targeted areas will include the multi-family stock study, the extended low-income tax credit program, the rent control study, and fair housing activities.

R&D budget authority for community and regional development
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$74	$77	$100	29.4%
Tennessee Valley Authority	57	56	52	-6.4
Department of Housing and Urban Development	17	20	47	138.4
Housing markets	13	14	16	17.0
Housing programs	1	4	3	-27.5
Safety and standards	1	1	1	0.0
Fair housing	1	1	1	25.0
Local government management	(a)	(a)	1	250.0
Program evaluations	-	-	25	**
Research support	(a)	(a)	1	2173.9
Department of Commerce Economic Development Administration	1	1	-	*

(a) Less than $500,000.
* Proposed for elimination.
** Proposed new initiative.
SOURCE: National Science Foundation, SRS

ADMINISTRATION OF JUSTICE

R&D programs within the administration of justice function (function 750) are conducted by the Department of Justice and the U.S. Customs Service within the Department of the Treasury. In 1991, R&D funding for the administration of justice is proposed to increase by 1 percent to $45 million. Increased funding is scheduled for R&D activities of the Drug Enforcement Administration and the U.S. Customs Service. R&D programs account for less than one-half of 1 percent of total Federal budget authority for this function.

Over one-half of this function's R&D funding is for the Office of Justice programs within the Department of Justice. Emphasis is placed on research, development, evaluation, and dissemination activities to produce knowledge about the causes and control of crime and to deal with the complex problems of juvenile delinquency.

R&D budget authority for administration of justice
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$45	$44	$45	1.1%
Department of Justice	37	36	36	-1.4
Office of Justice Programs	23	26	25	-4.2
Federal Bureau of Investigation	7	5	5	0.0
Federal Prison System	6	4	4	0.0
Drug Enforcement Administration	1	1	2	50.0
Immigration and Naturalization Service	(a)	(a)	(a)	0.0
U.S. Customs Service (Treasury)	8	8	9	12.8

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

INCOME SECURITY

Federal programs in the income security function (function 600) are directed toward assistance in meeting the needs of individuals by insuring against loss of income resulting from disability, retirement, death or unemployment of a wage earner, and by helping the truly needy who can not provide for themselves. Federal R&D activities within the income security function are supported by the Department of Health and Human Services and the Pension Benefit Guarantee Corporation. In 1991, income security R&D programs are proposed to decrease by 25 percent, or $9 million, below 1990 levels to $26 million. The funding declines are attributable to proposed reductions in support for R&D at both the Social Security Administration and the Family Support Administration. R&D activities will account for only a fraction of 1 percent of total Federal budget authority for this function in 1991.

R&D budget authority for income security
[Dollars in millions]

	1989	1990	1991	Percent change 1990-1991
	actual	estimated	proposed	
Total	$27	$35	$26	-25.0%
Department of Health and Human Services	27	35	26	-25.1
Social Security Administration	16	20	17	-16.2
Family Support Administration	3	10	4	-56.1
Office of the Secretary-Policy Research	8	5	5	0.0
Pension Benefit Guarantee Corp	(a)	(a)	(a)	0.0

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

GENERAL GOVERNMENT

The general government function (function 800) includes the central management activities for both the executive and legislative branches of the Federal Government. Major activities of this function are Federal finances, tax collection, personnel management, and property control. R&D activities within the general government function are supported by the Internal Revenue Service and the U.S. Mint, both within the Department of the Treasury. General government funding for research and development is proposed to remain level at $17 million in 1991. R&D activities within this function will account for only a fraction of 1 percent of total Federal budget authority for general government in 1991.

R&D budget authority for general government
[Dollars in millions]

	1989 actual	1990 estimated	1991 proposed	Percent change 1990-1991
Total	$15	$17	$17	0.0%
Department of the Treasury				
Internal Revenue Service	15	17	17	0.0
U.S. Mint	1	-	-	-

SOURCE: National Science Foundation, SRS

Appendix: Historical Tables

BEST COPY AVAILABLE

Federally-funded R&D for national defense and civilian functions: fiscal years 1955-91 1/
(Dollars in millions)

	Current dollars			Constant 1982 dollars 2/			Percent of total	
Fiscal year 3/	Total	National Defense	Civilian Functions	Total	National Defense	Civilian Functions	National Defense	Civilian Functions
1955	$2,533	$2,151	$382	$9,378	$7,964	$1,414	84.9%	15.1%
1956	2,988	2,535	453	10,698	9,076	1,622	84.8	15.2
1957	3,932	3,327	605	13,577	11,488	2,089	84.6	15.4
1958	4,570	3,801	769	15,351	12,768	2,583	83.2	16.8
1959	6,694	5,556	1,138	21,991	18,252	3,739	83.0	17.0
1960	7,552	6,107	1,445	24,275	19,630	4,645	80.9	19.1
1961	9,059	7,005	2,054	28,814	22,281	6,533	77.3	22.7
1962	10,290	7,238	3,052	32,156	22,619	9,538	70.3	29.7
1963	12,495	7,764	4,731	38,352	23,831	14,521	62.1	37.9
1964	14,225	7,829	6,396	43,041	23,688	19,352	55.0	45.0
1965	14,614	7,342	7,272	43,301	21,754	21,547	50.2	49.8
1966	15,320	7,536	7,784	44,099	21,693	22,406	49.2	50.8
1967	16,529	8,566	7,963	46,003	23,841	22,163	51.8	48.2
1968	15,921	8,275	7,646	42,810	22,251	20,559	52.0	48.0
1969	15,641	8,356	7,285	39,901	21,316	18,584	53.4	46.6
1970	15,339	7,981	7,358	36,979	19,241	17,739	52.0	48.0
1971	15,543	8,110	7,433	35,600	18,575	17,025	52.2	47.8
1972	16,496	8,902	7,594	35,814	19,327	16,487	54.0	46.0
1973	16,800	9,002	7,798	34,747	18,618	16,128	53.6	46.4
1974	17,410	9,016	8,394	33,378	17,285	16,093	51.8	48.2
1975	19,039	9,679	9,360	33,100	16,827	16,273	50.8	49.2
1976	20,780	10,430	10,350	33,473	16,801	16,672	50.2	49.8
1977	23,450	11,864	11,586	34,984	17,700	17,285	50.6	49.4
1978	25,976	12,899	13,077	36,219	17,985	18,233	49.7	50.3
1979	28,208	13,791	14,417	36,211	17,703	18,507	48.9	51.1
1980	29,739	14,946	14,793	35,094	17,637	17,457	50.3	49.7
1981	33,735	18,413	15,322	36,192	19,754	16,438	54.6	45.4
1982	36,115	22,070	14,045	36,115	22,070	14,045	61.1	38.9
1983	38,768	24,936	13,832	37,195	23,924	13,271	64.3	35.7
1984	44,214	29,287	14,927	40,867	27,070	13,797	66.2	33.8
1985	49,887	33,698	16,189	44,730	30,214	14,515	67.5	32.5
1986	53,249	36,926	16,323	46,502	32,247	14,255	69.3	30.7
1987	57,069	39,152	17,917	48,364	33,180	15,184	68.6	31.4
1988	59,106	40,099	19,007	48,607	32,976	15,631	67.8	32.2
1989	62,115	40,642	21,473	48,963	32,037	16,927	65.4	34.6
1990 est.	63,805	39,877	23,928	48,231	30,143	18,088	62.5	37.5
1991 proposed	68,278	41,421	26,856	49,624	30,105	19,519	60.7	39.3

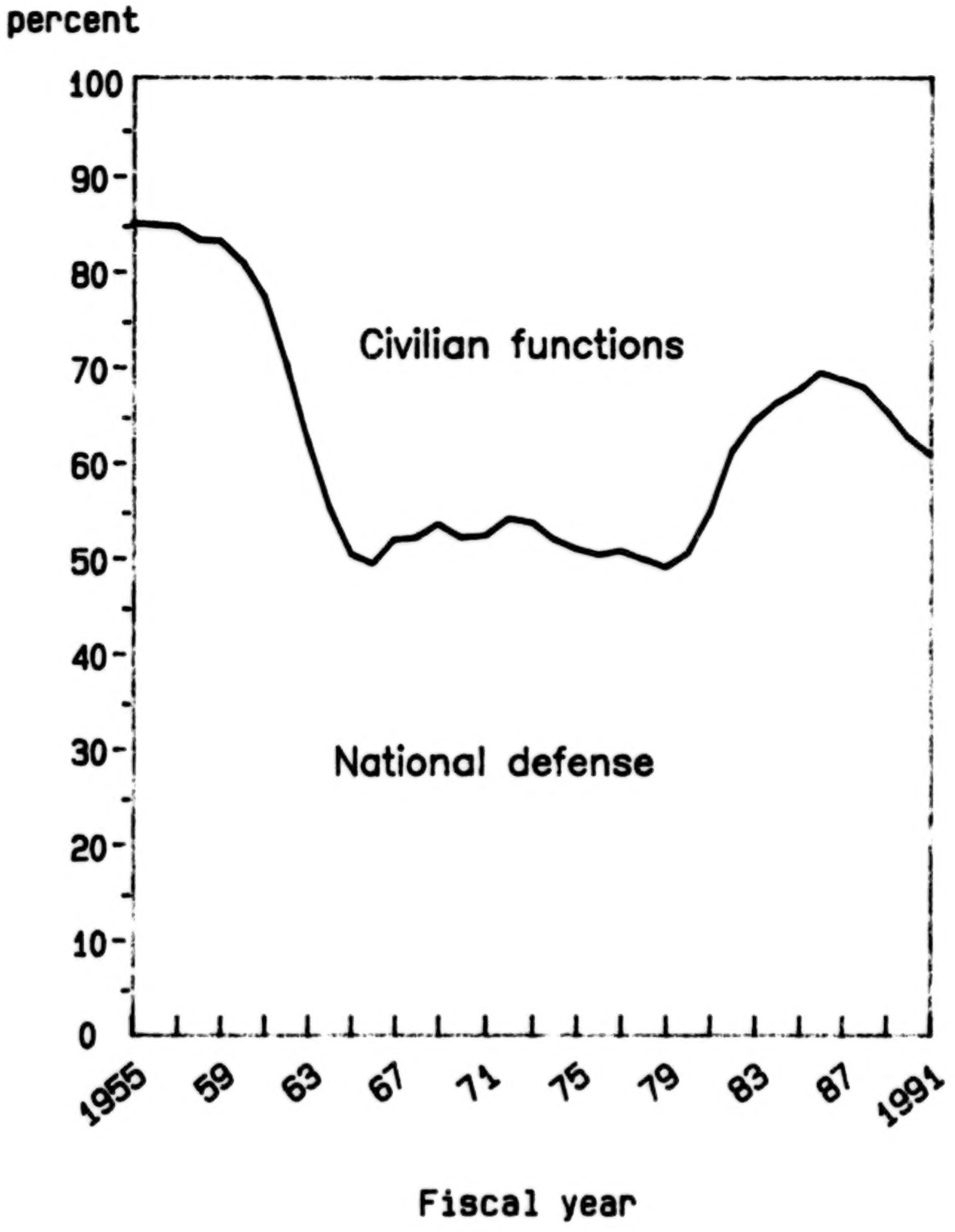
1/ The national defense function includes Department of Defense military activities and Department of Energy atomic energy defense programs. Civilian functions include all other Federally-funded R&D activities.

2/ Calculated using fiscal year GNP implicit price deflators with 1982 as the base year.

3/ Data for 1955-77 represent obligations. Data for 1978-89 are shown in actual budget authority. Data for 1990 are based on an estimate of budget authority. Data for 1991 are based on budget authority proposed by the administration.

SOURCE: National Science Foundation, SRS

Distribution of Federal R&D funds between national defense and civilian functions: FY 1955-1991



SOURCE: National Science Foundation, SRS

BEST COPY AVAILABLE

Federal R&D obligations by selected budget function: fiscal years 1955-60
[Dollars in millions]

Function	1955	1956	1957	1958	1959	1960
Total	$2,533	$2,988	$3,932	$4,570	$6,694	$7,552
National defense	2,151	2,535	3,327	3,801	5,556	6,107
Health	67	83	140	177	233	305
All other functions	315	370	465	592	904	1,140

SOURCE: National Science Foundation, SRS

Federal R&D obligations by selected budget function: fiscal years 1961-66
[Dollars in millions]

Function	1961	1962	1963	1964	1965	1966
Total	$9,059	$10,290	$12,495	$14,225	$14,614	$15,320
National defense	7,005	7,238	7,764	7,829	7,342	7,536
Health	405	551	626	728	792	900
Space research and technology	777	1,413	2,812	4,241	4,887	4,976
General science	137	187	246	277	304	377
Energy	373	448	515	571	585	575
Natural resources and environment	73	108	120	134	159	189
Transportation	55	101	142	122	147	251
Agriculture	125	136	146	165	195	201
All other functions	108	107	125	160	203	315

SOURCE: National Science Foundation, SRS

BEST COPY AVAILABLE

Federal R&D obligations by budget function: fiscal years 1967-72
[Dollars in millions]

Function	1967	1968	1969	1970	1971	1972
Total	$16,529	$15,921	$15,641	$15,339	$15,543	$16,496
National defense	8,566	8,275	8,356	7,981	8,110	8,902
Health	915	1,021	1,088	1,084	1,288	1,547
Space research and technology	4,778	4,304	3,799	3,606	3,048	2,932
General science	409	437	433	452	513	625
Energy	600	657	597	574	556	574
Natural resources and environment	320	331	323	340	416	479
Transportation	380	304	404	535	728	558
Agriculture	218	217	221	238	259	294
Education, training, employment and social services	154	166	169	164	215	235
International affairs	18	17	26	32	32	29
Veterans benefits and services	41	45	50	59	63	69
Commerce and housing credit	43	48	54	79	90	50
Community and regional development	37	44	32	47	65	66
Administration of justice	(a)	1	5	9	10	23
Income security	48	50	78	136	145	106
General government	3	5	5	6	7	8

Note: Data are shown in obligations.
(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Federal R&D obligations by budget function: fiscal years 1973-78
[Dollars in millions]

Function	1973	1974	1975	1976	1977	1978
Total	$16,800	$17,410	$19,039	$20,780	$23,450	$25,976
National defense	9,002	9,016	9,679	10,430	11,864	12,899
Health	1,585	2,069	2,170	2,351	2,629	2,968
Space research and technology	2,824	2,702	2,764	3,130	2,832	2,939
General science	658	749	813	858	974	1,050
Energy	630	759	1,363	1,649	2,562	3,134
Natural resources and environment	554	516	624	683	753	904
Transportation	572	693	635	631	708	768
Agriculture	308	313	342	383	457	501
Education, training, employment and social services	290	236	239	255	230	345
International affairs	28	24	29	42	66	57
Veterans benefits and services	74	85	95	98	107	111
Commerce and housing credit	50	51	65	69	71	77
Community and regional development	78	82	93	109	101	92
Administration of justice	33	35	44	35	30	44
Income security	106	71	72	48	55	67
General government	7	9	12	12	13	20

Note: Data for 1973-77 represent obligations. Data for 1978 are shown in actual budget authority.

SOURCE: National Science Foundation, SRS

BEST COPY AVAILABLE

Federal R&D funding by budget function: fiscal years 1979-85
[Dollars in millions]

Function	1979	1980	1981	1982	1983	1984	1985
Total	$28,208	$29,739	$33,735	$36,115	$38,768	$44,214	$49,887
National defense	13,791	14,946	18,413	22,070	24,936	29,287	33,698
Health	3,401	3,694	3,871	3,869	4,298	4,779	5,418
Space research and technology	3,136	2,738	3,111	2,584	2,134	2,300	2,725
General science	1,119	1,233	1,340	1,359	1,502	1,676	1,862
Energy	3,461	3,603	3.501	3,012	2,578	2,581	2,389
Natural resources and environment	1,010	999	1,061	965	952	963	1,059
Transportation	798	887	869	791	876	1,040	1,030
Agriculture	552	585	659	693	745	762	836
Education, training, employment and social services	354	468	298	228	189	200	220
International affairs	117	125	160	165	177	192	210
Veterans benefits and services	123	126	143	139	157	218	193
Commerce and housing credit	93	101	106	104	107	110	114
Community and regional development	127	119	104	63	44	46	50
Administration of justice	47	45	34	31	37	24	47
Income security	57	47	43	32	32	26	21
General government	23	22	22	10	6	8	17

Note: Data are shown in actual budget authority.

SOURCE: National Science Foundation, SRS

Federal R&D funding by budget function: fiscal years 1986-91
[Dollars in millions]

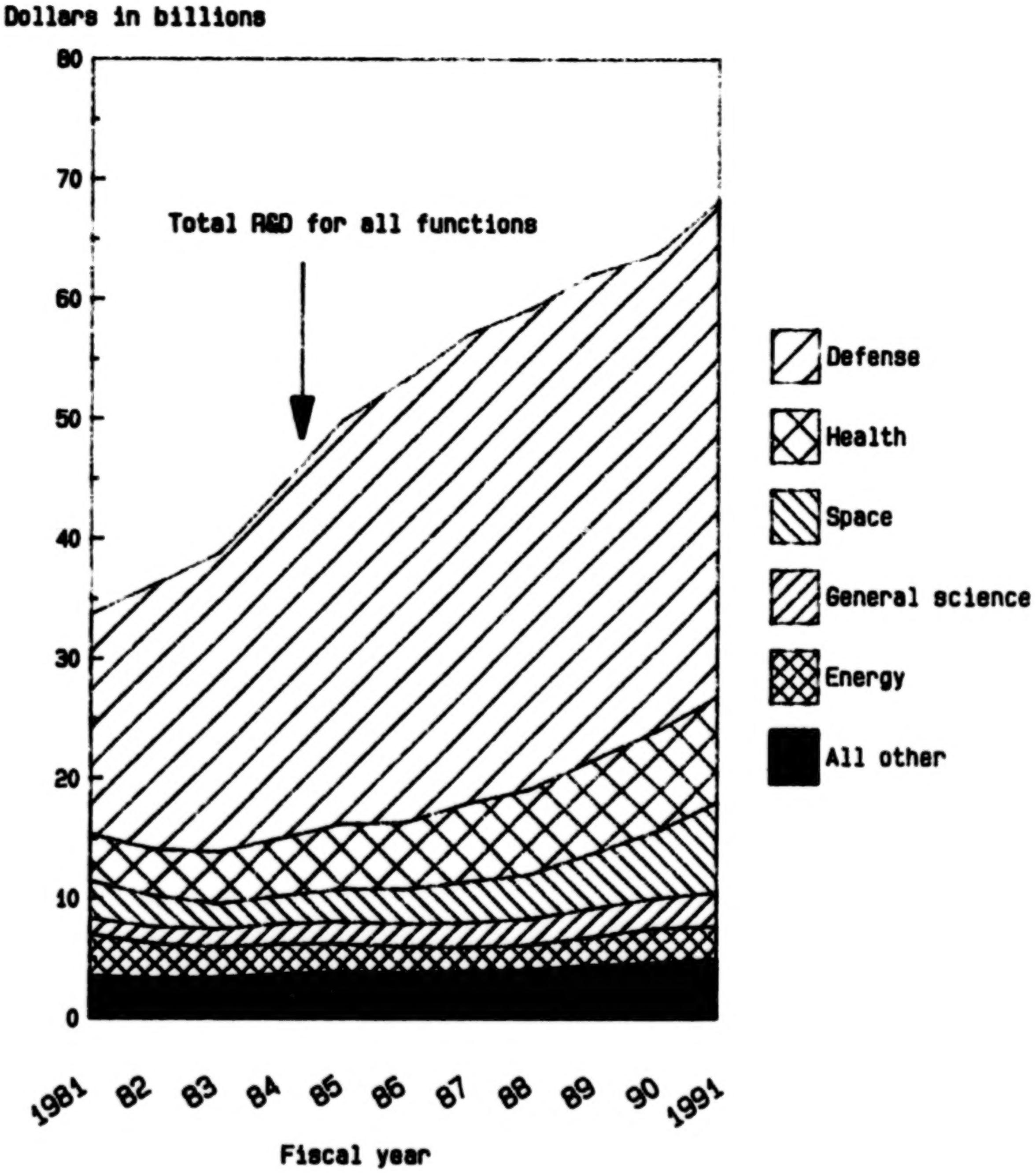
Function	1986	1987	1988	1989	1990 est	1991 prop
Total	$53,249	$57,069	$59,106	$62,115	$63,805	$68,278
National defense	36,926	39,152	40,099	40,642	39,877	41,421
Health	5,565	6,556	7,076	7,773	8,358	8,793
Space research and technology	2,894	3,398	3,683	4,555	5,577	7,556
General science	1,873	2,042	2,160	2,373	2,499	2,813
Energy	2,286	2,053	2,126	2,419	2,991	2,761
Natural resources and environment	1,062	1,133	1,160	1,255	1,362	1,408
Transportation	917	908	896	1,064	1,144	1,342
Agriculture	815	822	882	907	949	1,010
Education, training, employment and social services	248	267	285	347	390	410
International affairs	211	223	224	279	212	219
Veterans benefits and services	183	215	195	212	215	201
Commerce and housing credit	111	110	122	128	139	158
Community and regional development	88	99	108	74	77	100
Administration of justice	41	49	51	45	44	45
Income security	14	25	23	27	35	26
General government	14	17	17	15	17	17

Note: Data for 1986-89 are shown in actual budget authority. Data for 1990 are estimated and data for 1991 are proposed based on the FY 1991 budget.

SOURCE: National Science Foundation, SRS

BEST COPY AVAILABLE

R&D budget authority
by major function



SOURCE: National Science Foundation, SRS

BEST COPY AVAILABLE

Budget authority for basic research by function: fiscal years 1978-84
[Dollars in millions]

Function	1978	1979	1980	1981	1982	1983	1984
Total	$3,665	$4,108	$4,716	$5,107	$5,305	$6,247	$7,072
Health	1,246	1,579	1,761	1,951	1,953	2,475	2,813
General science	962	1,026	1,152	1,256	1,296	1,439	1,606
Space research and technology	412	440	482	445	434	501	646
National defense	320	365	552	610	696	788	845
Energy	157	172	200	220	260	320	365
Agriculture	197	222	246	281	295	326	353
Natural resources and environment	207	131	136	131	139	156	192
Transportation	70	75	79	89	102	117	125
Education, training, employment and social services	57	59	61	66	78	70	77
Commerce and housing credit	9	10	15	17	17	19	20
Veterans benefits and services	9	10	14	15	13	14	15
Administration of justice	10	10	9	5	4	4	5
Community and regional development	8	8	8	5	7	6	5
General government	-	(a)	(a)	3	2	3	3
International affairs	(a)	-	-	12	10	10	3
Income security	2	1	1	3	-	-	-

(a) Less than $500,000.

Note: Data are shown in actual budget authority.

SOURCE: National Science Foundation, SRS

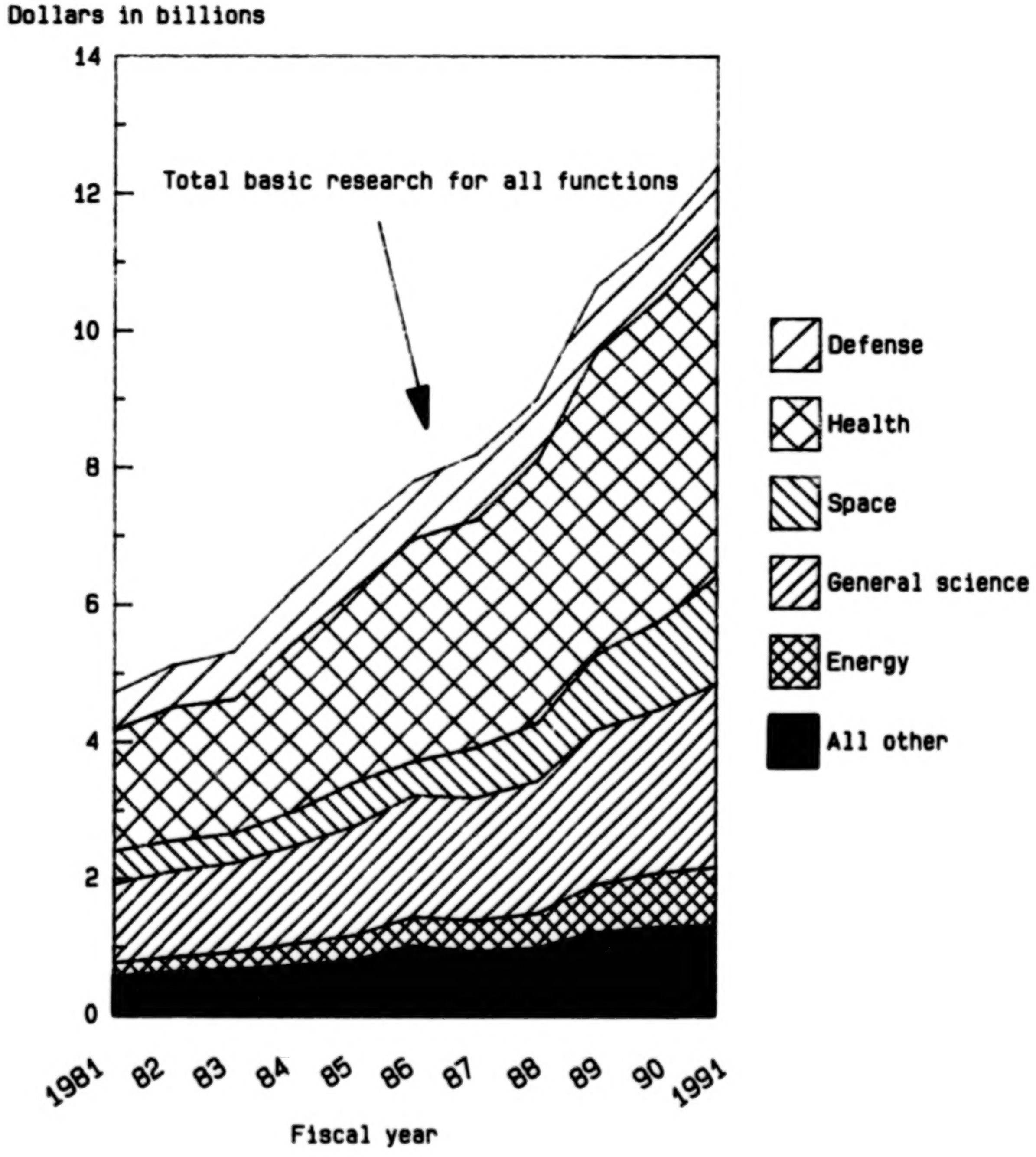
Budget authority for basic research by function: fiscal years 1985-91
[Dollars in millions]

Function	1985	1986	1987	1988	1989	1990 est	1991 prop
Total	$7,810	$8,193	$9,021	$9,553	$10,648	$11,400	$12,384
Health	3,243	3,324	3,851	4,087	4,413	4,714	4,993
General science	1,779	1,795	1,942	2,061	2,265	2,384	2,683
Space research and technology	498	737	843	944	1,099	1,284	1,554
National defense	856	960	900	905	965	939	994
Energy	428	456	511	571	703	797	847
Agriculture	406	390	397	428	433	452	487
Natural resources and environment	206	204	206	210	331	376	384
Transportation	255	184	231	197	287	288	270
Education, training, employment and social services	86	83	78	83	92	99	112
Commerce and housing credit	23	26	26	28	29	29	33
Veterans benefits and services	15	15	17	17	16	16	15
Administration of justice	4	5	8	8	7	9	6
Community and regional development	6	6	4	7	3	3	3
General government	4	5	4	5	3	3	3
International affairs	4	5	3	3	3	5	2
Income security	-	-	-	-	-	-	-

Note: Data for 1985-89 are shown in actual budget authority. Data for 1990 are estimated and data for 1991 are proposed based on the FY 1991 budget.

SOURCE: National Science Foundation, SRS

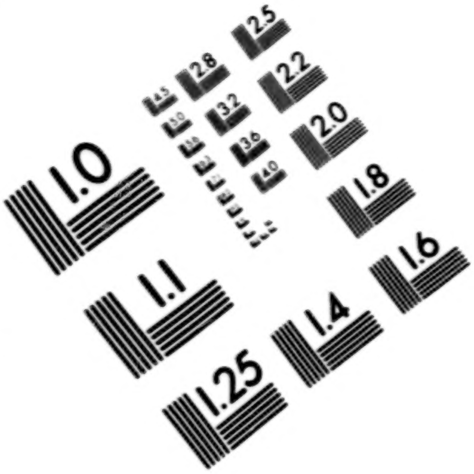
Basic research budget authority by major function

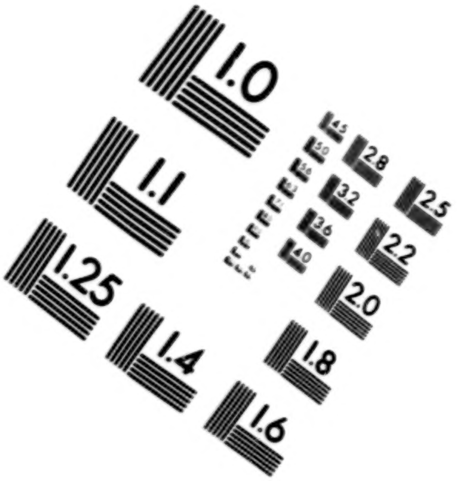


SOURCE: National Science Foundation, SRS

TOP

Film Identification

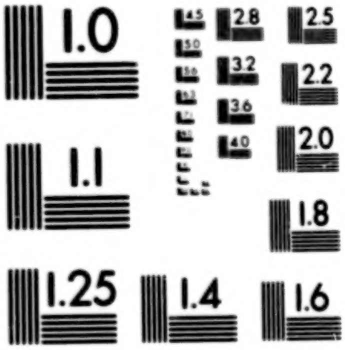




Century

1303 Geneva Avenue
St. Paul, MN 55119

PRECISION℠ RESOLUTION TARGETS



LEFT

RIGHT

150 MM

6″

PM-3 8½″x11″ PHOTOGRAPHIC GENERAL TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT

N 95/ 19391